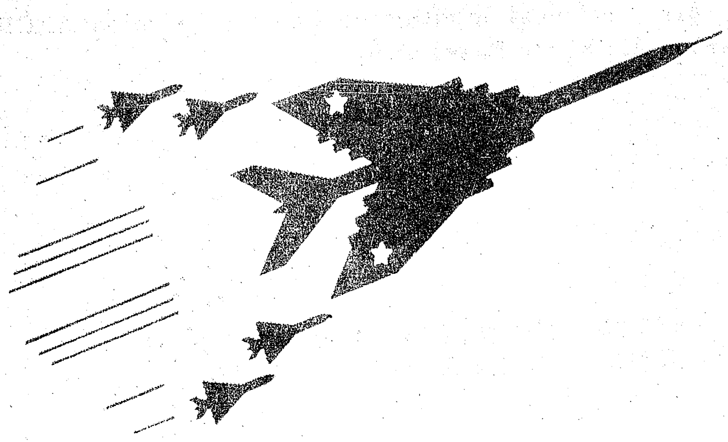
TRANSLATION

HERALD OF THE AIR FLEET

STAT



8

1957

EXPLANATORY NOTE

This publication is a translation of Herald of the Air Fleet, (Vestnik Vozdushnogo Flota) a monthly journal of the Soviet Air Force published by the Military Publishing House, Ministry of Defense, USSR.

Every effort has been made to provide as accurate a translation as practicable. Soviet propaganda has not been deleted, as it is felt that such deletion could reduce the value of the translation to some portion of the intelligence community. Political and technical phraseology of the original text has been adhered to in order to avoid possible distortion of information.

Users and evaluators of this translation who note technical inaccuracies or have comments or suggestions are urged to submit them to: Commander, Air Technical Intelligence Center, Attention: AFCIN-4B, Wright-Patterson Air Force Base, Ohio.

AIR TECHNICAL INTELLIGENCE TRANSLATION

(TITLE UNCLASSIFIED)

HERALD OF THE AIR FLEET
(Vestnik Vozdushnogo Flota)

8

1957

AIR TECHNICAL INTELLIGENCE CENTER
WRIGHT-PATTERSON AIR FORCE BASE
OHIO

AF-WP-O-JUL 58 400

THE HEROIC ARMY OF A BROTHER PEOPLE

The Chinese people are marking a glorious historical date. Thirty years of the Chinese People's Liberation Army have been completed. This is a day of great joy, not only to our Chinese friends, but also to every Soviet individual, to all honest people on earth who follow the immense progress of New China with respect and love.

For many hundreds of years the vast country which spreads from the Pacific Ocean to the snow-clad summits of Karakorum and the shifting sands of the Gobi desert was under the yoke of Chinese and foreign exploiters. The national resources were plundered by greedy predatory imperialists and their Chiang Kai-shekist accomplices. Workers and farmers, all of China's people endured terrible tortures and suffering at the hands of feudal lords and militarists, who made fabulous profits from the people's misery. But the hour of great battles had come. The Communist Party roused the mass of people to a war of liberation. The Peoples Liberation Army was the mighty force by which the Chinese people crushed the Kuomintang hordes and the imperialistic armies, and won the freedom and independence of their native land.

The Chinese Peoples Liberation Army came into being in the fire of the Nanchang insurrection on 1 August 1927. In that period the troops of the Nationalist army, among whom the Communists were carrying on large-scale orientation work, turned their weapons against the reactionary Kuomintang government and went over to the Revolution. That was a great victory for China's revolutionary forces. A powerful uprising of peasants soon took place in the provinces of Hunan, Hupeh, Shansi and others. As a result of these events the first units of the Chinese Revolutionary Army were organized under the leadership of the Communist Party of China.

The history of the Chinese Peoples Liberation Army has had four periods of development. During the first period (1927 - 1936) the Chinese people, relying on this Army, waged a revolutionary civil war against the large landowners and the bourgeoisie. In carrying out this task, the army did not limit itself to armed struggle alone, but also organized the mass of people and carried on extensive political propaganda for China's Communist Party. During the second period (1937 - 1945) the Peoples Liberation Army of China fought as a united national front against the Japanese invaders. After the defeat of imperialistic Japan the third period began. On its way to victory, the Chinese Army had to endure the most difficult trials in its struggle against the reactionary Kuomintang clique, which wanted to turn back the Peoples Revolution with the help of its foreign masters. And finally, in 1949, the fourth period began. New tasks now confronted the Chinese Peoples Liberation Army: to defend the building-up of socialism in their native land; to safeguard the sovereignty, the territorial integrity, and the safety of the country; to be ready at any time to liberate the island of Taiwan where the followers of Chang Kai-shek are still entrenched; to stand vigilantly guarding peace and security.

The history of the formation of the glorious Chinese revolutionary armed forces

THE HEROIC ARMY OF A BROTHER PEOPLE

The Chinese people are marking a glorious historical date. Thirty years of the Chinese People's Liberation Army have been completed. This is a day of great joy, not only to our Chinese friends, but also to every Soviet individual, to all honest people on earth who follow the immense progress of New China with respect and love.

For many hundreds of years the vast country which spreads from the Pacific Ocean to the snow-clad summits of Karakorum and the shifting sands of the Gobi desert was under the yoke of Chinese and foreign exploiters. The national resources were plundered by greedy predatory imperialists and their Chiang Kai-shekist accomplices. Workers and farmers, all of China's people endured terrible tortures and suffering at the hands of feudal lords and militarists, who made fabulous profits from the people's misery. But the hour of great battles had come. The Communist Party roused the mass of people to a war of liberation. The Peoples Liberation Army was the mighty force by which the Chinese people crushed the Kuomintang hordes and the imperialistic armies, and won the freedom and independence of their native land.

The Chinese Peoples Liberation Army came into being in the fire of the Nanchang insurrection on 1 August 1927. In that period the troops of the Nationalist army, among whom the Communists were carrying on large-scale orientation work, turned their weapons against the reactionary Kuomintang government and went over to the Revolution. That was a great victory for China's revolutionary forces. A powerful uprising of peasants soon took place in the provinces of Hunan, Hupeh, Shansi and others. As a result of these events the first units of the Chinese Revolutionary Army were organized under the leadership of the Communist Party of China.

The history of the Chinese Peoples Liberation Army has had four periods of development. During the first period (1927 - 1936) the Chinese people, relying on this Army, waged a revolutionary civil war against the large landowners and the bourgeoisie. In carrying out this task, the army did not limit itself to armed struggle alone, but also organized the mass of people and carried on extensive political propaganda for China's Communist Party. During the second period (1937 - 1945) the Peoples Liberation Army of China fought as a united national front against the Japanese invaders. After the defeat of imperialistic Japan the third period began. On its way to victory, the Chinese Army had to endure the most difficult trials in its struggle against the reactionary Kuomintang clique, which wanted to turn back the Peoples Revolution with the help of its foreign masters. And finally, in 1949, the fourth period began. New tasks now confronted the Chinese Peoples Liberation Army: to defend the building-up of socialism in their native land; to safeguard the sovereignty, the territorial integrity, and the safety of the country; to be ready at any time to liberate the island of Taiwan where the followers of Chang Kai-shek are still entrenched; to stand vigilantly guarding peace and security.

The history of the formation of the glorious Chinese revolutionary armed forces is closely connected with the names of Mao Tse-tung, Chu Teh, Peng Teh-huai, and other outstanding leaders of the Chinese people. "This Army," says Comrade Mao Tse-tung, "is strong in that the people who joined it are self-disciplined people. They joined together and are fighting not for the mercenary interests of a few men or of some small group, but for the interests of broad masses of the people, for the interests of the entire nation. To coalesce closely with China's masses, to serve the Chinese people devotedly — such is the only aspiration motivating this Army."

The fact that the army has become a true Peoples Army has made it indestructible. China's young Peoples Liberation Army had to overcome enormous difficulties. The enemy had guns, tanks, and aircraft. The American imperialists were not chary with loans and armament supplies for the Kuomintang factions. In only a single campaign against the Chinese Liberation Army there were 150 American and Canadian pilots participating, whereas the Peoples Army was lacking in even the simplest weapons which had to be taken in battle.

The enemy had a considerable numerical superiority. There was a time when 160,000 soldiers of the Peoples Liberation Army fought against an army of 700,000 on the side of Chiang Kai-shek. However, even this could not stop the aroused people. Through fire and smoke marched the units of New China. They did not weaken in battle; on the contrary, they became even stronger as more and more soldiers joined their ranks. By the beginning of 1932 the Peoples Liberation Army had grown to 300,000 men, and later there were more than a million. In the course of crushing the Kuomintang hordes, the number of men in the Peoples Liberation Army reached almost four million. This is the most striking evidence of the drawing power of the ideas for which the soldiers of New China were fighting under the leadership of the Communist Party.

The struggle was very hard. Fearing the growth of the revolutionary forces, the counterrevolutionary Kuomintang clique tried in every way to strangle the Peoples Liberation Army. Using its numerical and technical advantages, and enrolling German and American generals as advisers, it blockaded the revolutionary units many times, but to no avail.

The Great March to the Northwest is inscribed in golden letters in the history of the Chinese Peoples Liberation Army. Having broken through the ring of the Kuomintang blockade, the soldiers covered about 13,000 km, fighting along the way. They traversed uninhabited steppes and mountains covered with eternal snow, forced crossings over dozens of rivers, and repeatedly broke out of encirclements, continuously repelling enemy attacks. The successful completion of the Great Northwestern March proved convincingly the invincibility of a people aroused in the cause of their liberation.

In 1946 the Chiang Kai-shek clique controlled 80% of China's territory including all the large cities and the greater part of the railroad lines. By this time the United States had equipped 166 Kuomintang divisions. From October 1945 to July 1946 alone, they gave to the Kuomintang, besides infantry and artillery armament, 800 aircraft, 200 naval vessels of various classes, 12,000 armored vehicles and trucks, and other armament. Nevertheless this new venture of the trouble-makers also collapsed before the all-conquering wave of the people's wrath.

The Chinese people frustrated the enemy's plans. Again, as before, the Peoples Liberation Army increased its ranks while advancing, improved its combat and moral and political qualities. In only three years of war the Kuomintang losses amounted to several million men. The losses in armament were also enormous: 50,000 field pieces, more than 300,000 machine guns, over one thousand tanks and armored cars, and many airplanes.

Now all these events are part of the past, but the people will never forget the great campaigns. They will never forget how the young peasants went to the front equipped with the most primitive weapons such as scythes and pitchforks. The people will never forget the fifteen young soldiers of the Peoples Liberation Army who, having donned enemy uniforms, secretly penetrated into the enemy camp, created a panic there and took a whole company of Kuomintang soldiers captive. "This is not an exceptional case in my division," wrote the division commander. "Every Red Army man is just waiting for an opportunity to show heroism."

No matter under what conditions the people of China and their Peoples Liberation Army found themselves, the Soviet Union always rendered them active and diversified assistance. After the signing of the Sino-Soviet non-aggression pact in 1938, Soviet volunteer pilots and other military specialists came to China to offer help in military operations. Their arrival took the arrogance out of the Japanese pilots. The Japanese command quickly transferred its air bases 500-600 km to the rear.

Soviet pilots accomplished immortal feats of heroism in the skies of China. Especially memorable to the Chinese people are the victories won by our pilots on 18 February 1938 in an air battle over the city of Wuhan and on 23 April of the same year over the island of Taiwan when Soviet military aircraft bombed remote Japanese air bases. The air battle of 29 April 1938 will also be remembered. The Soviet fliers engaged in combat with 36 enemy planes. In this air battle 12 Japanese bombers and 9 fighters were downed and the rest were put to flight. In 40 months of war against the Japanese invaders, 986 Japanese aircraft were downed and destroyed with the help of Soviet fliers.

In the course of WW II, the Soviet people helped the Chinese people to defeat utterly the Japanese Fascist invaders. The soldiers of the Soviet Army fought heroically for the liberation of the Chinese people, as though they were defending their native land. Thus, Soviet and Chinese brotherly friendship in combat was molded and strengthened.

A Peoples Republic was proclaimed in China on 1 October 1949. Comrade Mao Tse-tung said at that time: "Our national defense will be strengthened, and no imperialist will be permitted to invade our territory again. The armed forces of the people have to be preserved and developed on the basis of the heroic and well-tempered Peoples Liberation Army. We shall have not only a powerful land army but a powerful air force and a powerful navy as well."

How has the Peoples Liberation Army of China developed in the 30 years of its existence? Now it has all branches of service. Its personnel is persistently mastering military science and new combat technology. During training exercises the officers and men demonstrate their increased combat skill. There was a time when the Peoples Liberation Army of China had at its disposal a very small number of aircraft. Now they have their own Air Force supplied with the best combat equipment.

The Chinese military pilots, as well as all the men of the Peoples Liberation Army, must be on the alert all the time. The imperialists have not relaxed. The growing strength of Peoples China infuriates them. Again and again they provoke new military actions against Peoples China. But they cannot break the will of a people bent on building socialism. The events of recent years have proved this most convincingly.

When the American imperialists invaded Korea, thus creating a direct threat to China on its northeastern border, Chinese peoples volunteers came to help the brother Korean people. The long-suffering Korean land was burning from enemy bombings and artillery fire. But in the fire of the conflagrations true heroes were born. For example, there is Chinese pilot Cheng Chang-hua. He was not yet fifteen when he joined the ranks of the men fighting for the freedom of their people. He became a private and, later, a commander. The outfit in which Cheng Chang-hua served destroyed 47 enemy planes.

Air battles went on day and night both close to the ground and in the stratosphere. The defenders of Korea were learning to act decisively and to stand fast before the hateful enemy under any conditions. There were days when even the American yellow press panicked: "100% losses"— such was the headline in a reactionary American magazine which told about the results of an air battle. In this battle the Chinese pilots attacked a group of "Flying Fortresses." Three of them were downed, and the remaining five were heavily damaged.

Both in the air and on the ground victory over the enemy was being forged. During the military operations in Korea more than 300,000 Chinese Peoples Volunteers were decorated with titles of heroes, exemplary fighters, and fighters who had accomplished heroic deeds. Many thousands of soldiers were awarded orders and medals of the Korean Peoples Democratic Republic.

The Chinese land is still exposed to the attacks of Chiang Kai-shekist bands and American aggressors. Recently, for instance, the press reported new violations of Chinese air space by Chiang Kai-shekist and American aircraft. Planes of the aggressors not only break into the territory of China but in a gangster-like way fire at and bomb the peaceful population.

Chinese pilots and all the men of the Peoples Liberation Army are constantly in combat readiness. Their faces are hard, their eyes are vigilant, and their hands hold firmly the weapons given to them by the people. They give the aggressors the rebuff they deserve.

The Peoples Liberation Army has reached its Thirtieth Anniversary strong and hardened. Under the leadership of the Communist Party it is a reliable defender of the revolutionary achievements of the Chinese people. It is an army of the new type, imbued with a spirit of patriotism and internationalism. It reliably guards the interests of the Chinese Peoples Republic and vigilantly protects the borders of its country.

NIGHT TRAINING OF PILOT AND NAVIGATOR

Night flying is one of the most complex aspects of combat training. Its difficulty is caused by the fact that night flying is primarily instrument flying, which requires intensified attention on the part of the flying personnel, as well as a great exertion of moral and physical energies. Piloting an aircraft at night, even under normal weather conditions, has, in contradistinction to daytime flying, a number of characteristic features which complicate carrying out a mission. Among these are: the considerable difficulty of determining visually the aircraft's position in space; the artificial illumination of the flight and navigation instruments and equipment in the pilot's compartment and that of other members of the crew; the absence of visibility or the distortion of the natural horizon on a dark night; the difficulty in determining the distance to the pinpoint and area light check points; the reflections on the glass surfaces of the cockpit enclosure.

The flying personnel encounters even greater difficulties if night flying is carried out under adverse weather conditions, when the possibility of visual piloting is completely precluded. At this time air navigation is carried out only through the use of electronic and astronomical facilities, while bomb sighting is carried out only by means of electronic facilities.

Night flying is within the capacity of every pilot and navigator. But there are many difficulties of all kinds on the path towards combat skill. In order to surmount them, the pilots, navigators, radio-gunners, technical personnel, and all specialists must exercise a maximum of persistence and tenacity, high discipline and good organization, and — above all — they must have an excellent knowledge of their work and systematic training.

There are many commanders in the Air Force, who regard seriously the organization of training classes for the flying personnel. For example, such classes have been well organized in the group commanded by officer Ye. I. Kravtsov. They are conducted by experienced leaders on a high methodological level, with perfect simulation of all the operations of the pilot and the navigator in the scheduled flight. A great deal of attention is given here to the development of the correct sequence of operations by the crew members in special cases of flying. The classes are very useful; consequently it is not fortuitous that every officer is interested in them.

The practical training of flying personnel at night begins with the development of the elements of piloting technique under normal weather conditions. And this is understandable. Faultless piloting technique is not an end in itself but rather a means for mastering the elements of combat application.

At every one of the stages in training it must be remembered that an error occurring there which is not eliminated can lead to grave consequences later on. Let us examine at least one such instance where a pilot, taking off in an Il-28 aircraft, raises the nose wheel, sometimes too soon and sometimes too late. Let us assume that the instructor noticed this error but attached no significance to it. Then in a solo night flight it can give rise to a more serious error, and that will be sufficient basis for a flying accident.

Or another example. While training a pilot to make a landing approach with the aircraft landing lights switched on and without any illumination from below by the ground floodlights, the instructor noticed that the pilot had a tendency, while making his landing computation, to descend lower than the prescribed altitude; but the instructor paid no attention to it. Yet, during solo flights, the pilot may commit the error of descending even lower and the glide path will be very shallow. As a result, at the very beginning of round-out, the light beam of the landing lights will turn out to be directed almost horizontally towards the runway and will illuminate it inadequately. Such an error will result in starting the round-out at too high an altitude, in violating the landing profile, and, as a rule, in a rough landing.

Lack of know-how in taking into account the peculiarities of the red light of the landing system signals is usually the cause of premature loss of altitude by individual pilots as they approach for a landing at night. The actual distance to those lights is deceptive at night and a false picture of the distance to the runway is created. The task of the commander lies not only in analyzing some error or other by the pilot on the ground but also in pointing out during flight how he must operate, and in giving him confidence in carrying out a given element of flight. At the same time one must not be guilty of such a dangerous practice during training as that of thinking: "He'll get it by himself", or "He'll get there with practice".

The same thing must also be said with regard to the training of flying personnel for instrument flying. Only the pilot who has perfectly mastered piloting technique visually and by instruments can be considered as trained for solo night flying. That is why it is important to organize the systematic training of the flying personnel even before the beginning of night flying. For this purpose, maximum use must be made of the TL-1 trainer.

After acquiring firm habits of flying on instruments on a TL-1, the pilot will more readily master the program of flying in a closed cockpit or in the cloud cover on a combat trainer and in a combat aircraft. Training on a TL-1 is particularly important for fighters, upon whom demands are made, as upon no one else, for exceptional speed of reaction as well as for swiftness of operations and the ability to spot, attack, and destroy the enemy under the most adverse conditions.

The technique of instrument flying is identical for both nighttime and the daytime. However, in order not to disrupt the flight regime, it must be remembered that at night turning one's attention away from the instruments for the sake of getting one's bearing visually and for the sake of caution is possible only for a very short time. Otherwise, on a dark night or over the sea, poorly experienced pilots may get a false impression of the position of the aircraft. In all instances the pilot must guide himself only by his instrument readings to determine the aircraft's position in space. Slowness and indecision are inadmissible here, for they may entail loss of one's orientation in space. The following example is typical. In unit X, pilot A. M. Shubin was carrying out his first solo flight along a flight route on a dark night at an altitude of 4500 m. Being without adequate experience, he tried to facilitate piloting by frequently turning his attention away from the instruments in order to determine the position of the aircraft by the light check points of which there were very few. As a result, it appeared to him that the craft was turning to the left. In order to correct the apparent turn he banked the craft to the right and, absorbed in making his course correction, came down too low. His subsequent actions were also wrong. He kept reestablishing the aircraft's position in accordance with the light check points. It must be observed that even the crew navigator was not able to help the pilot; he lost his head and displayed lack of discipline, and that complicated the situation even further.

That incident shows that piloting an aircraft on a dark night must be carried out only on instruments and the flying personnel must be so taught.

By training only individual crews in the technique of night flying it is impossible, of course, to solve all the problems of night training completely. One of the most complicated features of such training is flying in a group under normal and adverse weather conditions. Commanders must be very careful in granting permission for pilots to fly in a pair or in an element. It is not precluded that some pilots will not be able to master flying in a group and they should not be assigned such a task.

As a consequence of the great difficulty of visually determining and maintaining interval and distance between aircraft, the technique of group flying at night is markedly different from daytime flying. Group teamwork in flying must be developed among the personnel of permanent crews. Before the beginning of night flying, the commanders must organize detailed ground training of the flying personnel. Special attention should be given to such questions as adjusting the intensity of cockpit illumination, the illumination of the radio-gunner's compartment in the lead plane and his duties during the flight, the duties of the group leader on the ground and in the air, the actions of the lead pilot and of the wingmen during special cases of flight, studying the flight route with an indication of the place and order of assembly and breakup of the group.

In the solution of the problems of the night training of flying personnel, a great deal depends on the personal qualities of the commander-instructors. Above all, the instructor himself must know how to fly, bomb, and fire in an outstanding manner under any conditions. In the units and outfits of the Air Force there are many commanders who have mastered the skill of training flying personnel in night flying. Thus, officer A. I. Romanov successfully imparts his experience to his pilots. A high level of flying skill and a methodological background make it possible for him to show the trainee correctly how one element or another of flying must be carried out, how to analyze his actions, how to determine his inadequacies, and how to point out ways for eliminating them quickly.

It should be pointed out that successful execution of the combat training tasks of night training of pilot and navigator is unthinkable without a high degree of coordination in the crew, and the firm friendship and close cooperation of all its members. During a flight, it is very important for the actions of one member of the crew to complement those of another. In addition to the pilot and the navigator, there is a radio-gunner in the crew who, during any flight, from the time the engines are started up to the time of taxiing in to the parking area, carries out complex and varied duties, and is the combat assistant of the pilot and navigator.

The engineer, aviation technicians, mechanics, and all the specialists bear responsibility for the good working order of the aircraft. They must always remember that when they service an aircraft for a sortie there is nothing that is of secondary importance; that the slightest defect is the potential cause of a flying accident. Perfect functioning of all the assemblies of the aircraft inspires the flying personnel with confidence in carrying out their mission. The special features of night flying require precise functioning of all the instruments and other equipment of the aircraft, since the pilot notices any error during night flying later than he would during the daytime. Failure of even one instrument hampers the execution of the mission and frequently even makes it impossible. Consequently, the mechanics and instrument technicians must prepare all the instruments with special care.

Important and crucial tasks also face the personnel which services the ground facilities for air navigation. It is well known that not a single flight is possible without suitable ZOS [ground aids to navigation] facilities. Facilities for landing, vectoring, and control must always function efficiently, without any interruptions. Even brief interruptions in the functioning of ZOS facilities may have a negative effect on execution of the assigned mission. On the skill of the men servicing the ZOS facilities, on the accuracy of determining the target location depend the outcome of vectoring the fighters to the aerial target, the accuracy of bombing, and flying safety.

Great responsibility for carrying out night flying is placed upon the flight controller. Poor visibility hampers not only the flights but also control over them. In order to carry out his duties, the flight controller must have a good understanding of the entire procedure and of all the special features of night flying; he must, while at his place of work, feel the entire dynamics of the flight, and for this purpose, he must know how to fly under any conditions.

To control a matter without being familiar with its essence means to control blindly. The flight controller is a highly disciplined and exacting commander who does not allow the slightest infringement of the rules and requirements of flight service.

The outfit commanded by officer I. I. Yefremov serves as an example of good training and efficient control of flying by day and by night. He thinks over carefully the order for carrying out each flight scheduled in the planning table, and provides for everything down to the last detail. In getting ready for flights, the commander makes a detailed study of the weather situation, of the special features of the flight area and of the alternate airfields, and takes into account the possibilities of utilizing electronic facilities.

While controlling the flights, officer Yefremov never forgets the main task of the flight controller — to guarantee complete flying safety and strict order on the ground and in the air. By making active use of electronic facilities he always knows the location of each aircraft. Information on changes in the weather and in flight conditions has been organized in an exemplary fashion in the outfit. Furthermore, the flight controller has good radio contact with the alternate airfields and the bombing range. Since he knows the special features of night flying and the swiftly changing climatic conditions in the area of his airfield, Yefremov follows all changes in the weather situation attentively. Efficiency and strictness in controlling flights, without a shadow of rudeness or panic, discipline the pilots and inspire confidence in them. The pilots know that in a difficult moment during the flight they will receive help in good time and will be able to get out of the serious situation. It must be observed that during the organization and control of flights in this outfit, particularly serious attention is given to stacking the aircraft, not only on the flight route but also in the area of the airfield.

But unfortunately we also still have among us flight controllers who allow flagrant violations of the rules of flight service and who, by their actions, fail to guarantee flying safety. For example, a whole number of deviations from the rules of flight service was committed by officer Z. G. Finkel'shteyn while he was night flight controller. His irresponsible attitude towards execution of his service duties resulted in the unsuccessful termination of the flights that night.

The night training of flying personnel must not even for a minute escape the field of vision of the Political Agencies and Party Organizations. The "Instructions to the Organizations of the CPSU in the Soviet Army and Navy", confirmed by the Central Committee of the CPSU, require that the Party Organizations have a deep understanding of all aspects of combat training. That means that the guarantee of a solution for the complex tasks of night training must attract the special attention of the Party Organizations.

Training the flying personnel to fly in an outstanding manner, to fire and bomb accurately, to intercept aerial targets and to destroy them at night, means solving a problem of great State importance. A high level of night training intensifies the combat readiness of the units and outfits of the Air Force and makes it possible for our Air Force to operate under any conditions by day and by night.

A FIGHTER ATTACK IS REPULSED

(At Air Force Exercises)

Lt. Col. V. P. Kopylov

Bombers are designed for striking blows against ground objectives. In the interest of carrying out their basic mission they usually strive to avoid aerial combat, for which purpose, as a rule, provision is made for a fighter evasion maneuver — flight along a broken course with a change in speed and altitude. If, however, they do not succeed in avoiding an encounter with the enemy, bombers are forced to conduct active defensive combat, attempting to disrupt fighter attacks and, if possible, to hit them with precision fire. For this they use speed, direction and flight altitude maneuvers, and closing or opening the combat formation along the front and in depth.

However, the possibilities of a fighter evasion maneuver by bombers are limited. After assembling the group and gaining the required altitude on the flight route, the navigator determines the wind, for which a specified flight regime is maintained. Maintenance of the flight regime is also necessary before reaching the NBP [initial point of bomb run], when the crew switches on and adjusts in the automatic pilot. The carrying out on the bombing run of any maneuver unrelated to the lateral course setting is out of the question.

Thus, in the majority of cases, a fighter evasion maneuver can be executed only on the flight route, long before the target approach, when the probability of an encounter with enemy fighters is still small. But if flight is made to the maximum operational radius, then it is also not desirable to carry out the maneuver, since it shortens the flight range. A change in course and speed, for the purpose of disrupting fighter attacks and not provided for by the flight plan, considerably hinders spotting the target and approaching it at the required time.

But what is to be done if an encounter with fighters, nevertheless, takes place? The answer is simple — know how to combine maneuvering with precision firing. Only thus is it possible to overcome successfully the countermeasures of enemy fighters.

In one exercise a group of bombers was assigned the mission of striking a blow against an "enemy" objective at a prescribed time. Analyzing the tactical and aerial situation, the commander established the fact that fighters can intercept their group even prior to their approach to the "front" line. It was not possible to use a fighter evasion maneuver since they were flying with maximum radius. Consequently, it was necessary to prepare for repulsing the attacks.

Preparing for flight, the crews acquainted themselves in detail with the conditions under which they were to carry out their mission. The commander thought out in detail the organization of air observation and warning of the "enemy's" approach, and outlined variants of the combat formation while repulsing fighter attacks, especially emphasizing the importance of precision aimed fire by radio gunners and of mutual fire support among the crews.

After taking off and gaining the required altitude the bombers intercepted the flight route, where they found themselves in broken cirrus overcast. Under these conditions they were intercepted by fighters 15-20 km from the "front" line and were attacked successively by pairs. However, despite limited visibility, the bomber crews spotted the "enemy" in good time, thanks to which the pilots took up the positions in the combat formation assigned by the commander, and the aerial radio gunners got ready to fire. The radio gunners of aircraft directly subject to attack conducted tracking fire, and the others supported them with obstruction fire. The fighters were repulsed by simultaneous well-aimed fire.

The bombers won this air battle because air observation was well organized, the crews were warned in good time of the threat of attack, and precise and uninterrupted control was established. The commander made a correct choice of combat formation, guaranteeing mutual fire support among the aircraft for repulsing "enemy" attacks. The crews quickly took up their position in formation.

But even when observing all these provisions fighters can inflict considerable losses on bombers when aerial radio gunners are poorly trained in conducting precision aimed fire. The interpretation of photostrips showed high accuracy of fire. In the evaluation of it only the bursts delivered from the range of effective fire were considered, along with the organization of fire coordination and support within the group. The precision fire of aerial radio gunners and its correct organization are the main prerequisites for the defense of combat formations.

It is well known that aerial combat is brief. In this short period of time the will and training of crews are put to the severest test. Only courage, discipline, high morale and excellent training of flying personnel for the defense of combat formations will bring success to bombers in aerial combat.

Insofar as the deciding factor in repulsing fighters is precision fire, we subordinate the entire process of training aerial radio gunners to the main task — inculcating in them the habits of sniper fire at aerial targets. Training in precision fire is not an easy task. It includes training for aerial gunnery on the ground, photo gunnery, combat gunnery in the air, and, finally, aerial combat with fighters.

All ground training is directed toward ensuring flight training. On the ground fixed practical habits are cultivated in determining initial data for firing, in aircraft identification, in working with sight setting, and in sighting aerial targets.

It is very important that the habits acquired be consolidated and perfected. Therefore we strive to avoid long breaks between training on the various gunnery trainers and directly in an aircraft. Regardless of whether aerial gunnery is planned for an impending flying day or not, aerial radio gunners are required to undergo training on gunnery trainers. On a flying day, if the nature of the flights permits, flight personnel conduct photogunnery from the ground against aircraft which are taking off. For this purpose, special trainers mounted on tripods were provided for the pilots and aerial radio gunners. Gunners, by training constantly in sighting, acquire habits of precision firing.

No less important is a thorough analysis of each air battle, bringing out the errors committed. During one training flight a bomber element was subjected to three attacks by fighter pairs. Among the crews in trail were young aerial radio gunner, Privates N. A. Goncharov and V. I. Zamaziy. After landing, the gunners reported that all three fighter attacks, in their opinion, were successfully repulsed. But when the photogunnery films were interpreted it became clear that both aerial gunners had begun delivering fire from distances exceeding the range of effective fire, and had used up the entire supply of FKP [camera machine gun] film while repulsing the first attack. Thus, analyzing the firing results we ascertained that the gunners were not able to estimate properly the distance to the target and delivered their camera fire too hastily.

For those aerial radio gunners for whom certain elements of gunnery do not come easily we organize supplementary training. During the first period of instruction some gunners were not able to track the target and to frame it correctly at the same time. Thus the habits of simultaneous target tracking and framing in aerial photogunnery did not come easily to Sergeant N. P. Svistunov for a long time. If he tried to frame the target correctly, then he would forget about tracking and vice versa. It was necessary to place the gunner under special supervision, to conduct supplementary training in photogunnery from the ground against aircraft taking off, and on a trainer under the direct guidance of an officer of the aerial gunnery service. Each photo firing was thoroughly analyzed and the errors were explained. The results soon became apparent. Whereas at first N. P. Svistunov had only poor and satisfactory evaluations, good ones subsequently began to appear, and lately he has been carrying out excellent photogunnery and combat gunnery.

Flights for firing from a camera machine gun are a stage of preparation for combat gunnery. They are conducted in order to cultivate in young gunners the habits of working in the air with sight settings and with the sight, and to give them practice in sighting aerial targets. In practice firing from combat weapons in the air they acquire habits of the combat application of aircraft artillery weapons and prepare themselves for conducting defensive aerial combat.

However, practice aerial gunnery is carried out under conditions far different from those under which actual combat takes place. A most complete picture of actual combat can be reproduced during the process of practice aerial combat, conducted jointly with fighters — provided, of course, it is correctly organized. Therefore, we organize practice aerial combat with particular care; we attempt to keep the crews participating in a sortie from knowing beforehand by how many fighters and

on what leg of the flight course they will be attacked. At the same time we require fighters to conduct active combat with bombers, utilizing various tactical methods.

It is at times difficult to organize aerial combat between bombers and fighters based on different airfields. Because of the lack of coincidence between flight days and between the different weather conditions in the areas where the fighters and bombers are based, flights are often aborted. The organization of aerial combat between individual crews is particularly complicated.

In order for all crews to obtain practice in conducting defensive aerial combat singly and within the composition of small groups, it is possible to practice the periodical landing of a fighter pair or flight on a bomber airfield. This will considerably simplify the organization of joint flights. However, while organizing joint aerial combat sorties from one airfield, we cannot simplify the air situation. For bombers the element of surprise in an encounter with fighters must be preserved, and the same is true for fighters training in the interception of aerial targets.

The organization of aerial combat in formation represents a certain amount of difficulty. For this the flying personnel must be skilled in air observation while flying in formation, in giving rapid and clear warning of the enemy; they must be skilled in the execution of maneuvers within the group by planes in trail as well as by the entire group, and also in mutual fire support among crews and components.

However, it is possible to drill in these elements not only in aerial combat flights. For example, flight personnel must undergo training in circumspection during each flight. In order to cultivate the habit of constant air observation we require crew commanders to listen periodically in flight to reports by gunners on the air situation. In group flights, whether it be a flight for purposes of formation drill or for combat application without aerial combat, the formation leaders train the wingmen in combat change of formation along the front and in depth with prescribed distances and intervals, and in group maneuvering.

Aerial radio gunners of lead crews are trained in fire control on the ground. For this purpose the instructor creates from bombers and fighter mockups in the classroom different variants of the air situation. The radio gunners are stationed in accordance with combat considerations. The instructor, imitating with the aid of mockups the different stages and variants of aerial combat, trains the gunners in giving warning of the enemy, and instructs the leaders in giving commands and in fire control.

If the training process is set up in this way, then practice aerial combat will be the final stage in the tactical preparation of bomber crews.

During a sortie for carrying out a regular exercise, "enemy" fighters (coming in out of the sun) attacked a bomber group. Because of poorly organized warning and fire control within the group, some of the aerial radio gunners could not quickly join in combat. The gunners opened "fire" from different ranges and some did not succeed in firing at all. Analyzing this battle, we became definitely convinced that it is necessary to shift the training of aerial radio gunners over to group aerial combat.

We have begun to devote great attention to crew coordination. There are cases in which insufficiently experienced aerial radio gunners forget before firing to set in the initial firing data or to set the sight on "gyro". In the course of combat, flight speed and altitude often change and the gunner may not notice this and may not introduce the correction into the mechanisms for computing altitude and speed. If the pilot or navigator does not inform him in time of the change in flight regime, an error in firing is inevitable.

Our pilots and navigators know which operations a radio gunner must carry out prior to firing in flight, and, inquiring by SPU [aircraft interphone system], they check the correctness of armament preparation for firing, and the radio gunners report on their operations to the crew commander.

Certain comrades, campaigning for the sequence of training to proceed from the less complicated to the more complicated, consider that aerial combat flights should be carried out at first by an individual crew and later in a group.

It is not possible to agree with this opinion. It is difficult to determine beforehand which type of aerial combat — that of an individual bomber or that of a group — will turn out to be more complex. Much here depends on existing conditions. If a pilot knows how to pilot an aircraft in a group, then we consider it senseless to establish such a sequence in aerial combat training.

In order to inculcate flight personnel with confidence in their technique, it is useful to organize aerial sham battles between a bomber and one or a pair of fighters, choosing for this purpose the better crews with perfect mastery of piloting technique and experienced in conducting aerial combat. It is best to conduct sham battles over the airfield so that flight personnel can observe from the ground the dynamics of the entire combat. For fighters this combat must be free and creative. The aerial radio gunner while observing fighter operations, is constantly required to inform the crew commander of their intentions and of the air situation. Attempting to disrupt or hamper a fighter attack, the pilot, taking account of the specific situation, uses a particular maneuver. General direction of the engagement (by radio from the alert command post) is entrusted to the commander organizing the aerial sham battle.

After conducting an aerial sham battle, a detailed analysis of it is conducted in the presence of all flight personnel with a report of ground observations, an analysis of crew reports and of camera firing results, and with the showing of films. This will aid in finding the most effective methods of conducting defensive combat with bombers.

Present-day systems of detecting aerial targets and the high flight speeds of fighters do not always permit bombers to avoid an encounter and combat with them. A high degree of crew coordination, the ability to conduct combat with tactical competence, and to repulse fighter attacks with precision fire will make it possible for bomber crews to overcome enemy countermeasures and to carry out the assigned mission successfully.

THE COMBAT CAPABILITIES OF FIGHTERS AND A METHOD FOR DETERMINING THEM

Candidate of Military Sciences Col. V. Ya. Kudryashov,
Lt. Col. P. G. Nikitin

For the correct utilization of fighter strength and an objective evaluation of the anticipated results of operations it is necessary to know the fighters' combat capabilities in the execution of a definite combat mission and in a specific situation. However, until this time it has not been possible, in our opinion, to consider the question of a method for determining combat capabilities as completely solved.

There is no uniformity of interpretation of the term "the combat capabilities of fighters." Various meanings are included in this concept. Thus, the probability of hitting the enemy in aerial combat, determined by the ballistic prediction or by the correlation of rounds per second from the weapons of the fighter and of the aircraft attacked by him, is sometimes taken as the basis of the combat capabilities of fighters.

The essence of this concept, it seems to us, is bound up with the result of carrying out a specific mission, the outcome of which is conditioned by various factors — the utilization of the aircraft's characteristics, the pilot's morale and training — constituting, as a whole, the combat potential. We believe that by the combat capabilities of fighters is rightly meant only that anticipated result which can be attained by carrying out a mission in its entirety — more precisely, the losses which can be inflicted on the enemy in the air.

The quantity representing the combat capabilities of an individual aircraft or of a group of fighters must answer the following questions: What is the magnitude of the mission which they are capable of carrying out? Or what results can be expected from the operations of a single aircraft or a group of them in a definite combat situation? Therefore, for example, the combat capabilities of a certain fighter unit in repulsing an enemy bomber raid will be represented by the number of bombers which it is capable of repulsing in a given situation.

Generally the carrying out of any combat mission will, in the last analysis, be conditioned by the fighters' capabilities of inflicting such losses against the air enemy as will force him to give up his intentions.

For the exact determination of the combat capabilities of fighters, all the factors on which they depend must be taken into consideration. Unfortunately, up to the present there is no such method and apparently it is extremely difficult to work one out.

Anticipated results of aerial combat, determined by a comparison of only the probability of a hit, or of the fighter and enemy aircraft rounds per second, are not borne out by reality. This is not accidental. As is well known, aerial combat is basically a combination of maneuvering and firing. Therefore, its result is determined mainly by the firing and maneuvering characteristics of aircraft. But in determining the result of a fighter's action against the enemy by a comparison of rounds per second or of the possibilities of mutual destruction, only the aircraft's firing capabilities are taken into consideration. But a fighter plane is a unique carrier of the arms mounted on it. Therefore, its capabilities of destroying aerial targets depend on how favorable the conditions created for the use of these arms are.

All this can be corroborated by means of an example. Let us suppose that the attacking side has jet aircraft at its disposal with a combat ceiling of 15 km and a maximum flight speed of 1200 km/hr. For the purpose of offering countermeasures, the side defending itself has fighters with rate of fire per second considerably exceeding the rate of fire per second from the weapons of the enemy aircraft, but is inferior to them in flight and tactical characteristics (combat ceiling 12 km, maximum speed 1000 km/hr). The question arises: Will the fighters of the defending side be able to repulse the enemy air raid with the enemy operating at altitudes of 14-15 km or at lower altitudes, but at maximum speed?

In the first case, without a doubt, the fighters of the defending side will not be able to repulse the enemy, regardless of their great firing capabilities. In the second, the execution of the mission will be limited, since the fighters will not be able to use their weapons effectively. In fact, even if they are vectored to an advantageous position for attacking the enemy aircraft, to a range of 1000 m in the rear hemisphere, in order to fire, it will be necessary for them to sight first. If only 3 seconds are spent on this, then by the moment of opening fire, taking into account the time of flight of the missiles, the target will have moved approximately 240-250 m away. Taking into account the initial range, this constitutes approximately 1200 m, i.e., the target will have already left the zone of effective fire of the fighters with more powerful artillery weapons. Practically speaking, it is very unlikely that they will hit it.

In determining a fighter's capabilities of hitting a target, it is impossible not to take into consideration as well the existing aerial situation and the pilot's morale and combat qualities. Consequently, the probability of a hit and a fighter's fire superiority over enemy aircraft still do not entirely characterize the fighter's capabilities of destroying aerial targets. This means that these data are not the only and final criterion for determining the anticipated result.

In order to find a criterion for determining the fighters' capabilities of destroying aerial targets, let us analyze aerial combat as a physical phenomenon. From this point of view it is possible to present it as a clash of two opposing forces. It is well known that in principle the greater force wins. This means that in aerial combat as well the one who is stronger, who has or attains superiority in the course of battle, wins.

It may be objected that in actual combat a weak enemy sometimes defeats a strong opponent. Such cases are very rare. But even if they are encountered, then, in the last analysis, it is, nevertheless, the result of a manifestation of greater force.

Besides this, it is not possible to consider the forces clashing in aerial combat as something homogeneous. They are an intricate complex of such component parts as the characteristics of the aircraft and of the weapons, the pilot's physical condition and morale, and his skill.

The objective factors conditioning the attainment of superiority by a fighter over the enemy in aerial combat are, above all, the aircraft's flight and tactical characteristics: maximum speed, rate of climb, service ceiling, braking time and time of acceleration to maximum speed, and maneuverability in the horizontal and vertical planes.

Obviously, the higher these fighter qualities are in comparison with those of the enemy, the greater the superiority over him will be and the easier it will be for the fighter to be able to overcome the enemy's countermeasures, to implement subjective factors more completely, and, as a result of all this, to use his weapons more successfully.

Therefore, we may assert that a fighter's superiority over an enemy aircraft in aerial combat determines the capability and degree of utilization of the power of the weapons mounted on it, i.e., it conditions the degree to which its firing capabilities may be realized. These capabilities, under given firing conditions, are determined by the ballistic prediction along with consideration of the nature of the target, of firing and sighting conditions, of the effectiveness of the ammunition and of the level of the pilots' training; and they are expressed by the probability of a hit. If the probabilities of a hit (W) and the degree of the fighter's superiority over the enemy (C) are known, then the fighter's capability of destroying aerial targets (B) can be found by the equation $B = CW$.

Thus, to determine a fighter's capability of destroying aerial targets it is necessary to know the probability of a hit (firing capabilities) and the degree of superiority of his flight and tactical characteristics over those of the target under attack.

In order to establish a method for determining the degree of a fighter's superiority in aerial combat, let us return to the analysis of the essence of aerial combat.

The superiority of one oppositely directed force over another is equal to the difference of these forces. And the surplus of greater force will characterize the degree of manifestation of its ascendancy over the lesser force. That part of the greater force which is equal to the lesser will be neutralized.

Considering aerial combat as a clash of oppositely directed forces, it is not difficult to establish that these forces are determined by the characteristics of the aircraft and pilots. The general result of a manifestation of superiority is an algebraic sum of the relations of the performance margins of a certain flight and tactical characteristic of a fighter to the corresponding characteristic of an opposing aircraft.

For example, an air battle is taking place between two fighters possessing the following characteristics: F_1 has a speed of 1100 km/hr, a maximum angular speed of 9°/sec, and a maximum vertical speed of 60 m/sec; F_2 has a speed of 1000 km/hr, a maximum angular speed of 10°/sec, and a maximum vertical speed of 60 m/sec. The fighters met under identical tactical conditions.

Let us determine the degree of superiority of one of them over the other. From a comparison of these characteristics one can see that the speed of fighter F_1 is greater than the speed of fighter F_2 by 100 km/hr and that fighter F_2 surpasses fighter F_1 in angular speed by 1°/sec. Making use of the explanation cited above, let us find the degree of superiority C. Solving the problem with regard to aircraft F_1 we get:

$$C = \frac{1100 - 1000}{1000} - \frac{10 - 9}{9} + \frac{60 - 60}{60} \approx - \frac{1}{90}.$$

If we solve the problem with respect to fighter F_2, we get the same quantity, but of the opposite sign. The value of the degree of superiority shows that, in a tactical air battle, overall superiority will be on the side of fighter F_2. This can guarantee him the possibility of realizing his fire power in aerial combat with fighter F_1 to 1/90 of its maximum value.

But if the first fighter does not enter into tactical aerial combat and avoids tactical errors, then fighter F_2, even with the above-mentioned degree of superiority, will not attain victory, since fighter F_1, possessing the superiority in speed, can prevent fighter F_2 from approaching the range of effective fire. This means that in aerial combat fighters must competenly utilize those aircraft characteristics in which they surpass the enemy aircraft.

It should be noted that the degree of a fighter's superiority over a target under attack may considerably exceed unity, as, for example, in combat with transport planes. It would seem that in such cases fighter capabilities of hitting aerial targets can be very great. However, this is not the case. A fighter's superiority over a target does not increase his fire power but only determines the degree of its utilization, by virtue of which the fighter's capabilities of hitting aerial targets cannot be numerically greater than the probability of a hit under the given firing conditions. A degree of fighter superiority greater than unity over a target under attack means that the fighter's firing capabilities may be used to their full extent.

Consequently, in those cases where the degree of a fighter's superiority over a target under attack exceeds unity, the fighter s capability of hitting aerial targets will be numerically equal to the probability of hitting these targets under the given firing conditions.

But if the degree of superiority is equal to zero, i.e., if the enemy planes (fighters, for example) do not have at their disposal the necessary superiority and cannot create it in the course of combat, they will not attain victory. In fact, when C is equal to zero, even with a great value of W, the possibility of a hit will be equal to zero, since $0 \cdot W = 0$.

The same picture is obtained in an inverse correlation of superiority and of the probability of a hit. The latter gives us the right to conclude that a fighter has at his disposal the greatest capability of destroying aerial targets when he has high firing characteristics and a degree of superiority not less than unity.

Experience shows that in order to obtain success in present-day fighter combat, superiority must be created early, before establishing direct contact with the target. This is explained by the fact that enemy planes can observe each other at considerable distances. When it is possible to control the closing in of fighters on an aerial target, they, without a doubt, will endeavor to attain superiority before entering into combat.

Thus, we have established that the criterion of the combat capabilities of fighters is their ability to inflict defeat on the enemy, which in turn depends on the probability of hitting the aerial target and on the degree of superiority of the fighter's flight and tactical characteristics over those of the enemy aircraft.

Knowing one fighter's capabilities, it is easy to find the anticipated result of action against the enemy for any group of fighters carrying out a specific combat mission. If the general composition of a group of fighters is designated by N_f, and the relation of the number of active fighters to the general composition of the group by the letter K, then the anticipated result of the action of this group against the

enemy (N) will be:

$$N = BKN_f, \text{ or } N = CWKN_f,$$

where N is the number of destroyed enemy aircraft.

From the possible result of the action of a group of fighters against enemy aircraft in a given situation (N), and from the losses which it is necessary to inflict upon the enemy in order to force him to give up carrying out his combat mission (P_n in %), it is possible to determine the combat capability of a given group of fighters in repulsing a bomber raid.

It will be expressed by the ratio $\frac{N}{P_n}$ %.

It should be noted that it is rather difficult to establish exactly the number (in percentages) of enemy aircraft which it is necessary to destroy in order to attain the above-mentioned objective, for the latter depends on the specific aerial situation and the morale and combat qualities of the flight personnel. Not excluded is the fact that the repulsion of a group of enemy aircraft will take place after it loses 25-30% of its general composition, as often happened during the years of WW II and the Great Patriotic War. In general there can be no guarantee that under definite conditions the enemy will not make great sacrifices, if only to reach his objective. As regards the repulsion of pilotless facilities for aerial attack or of individual aircraft at night and in the daytime under adverse weather conditions, here it is generally senseless to compute any sort of percentage of destruction, since all targets must be destroyed.

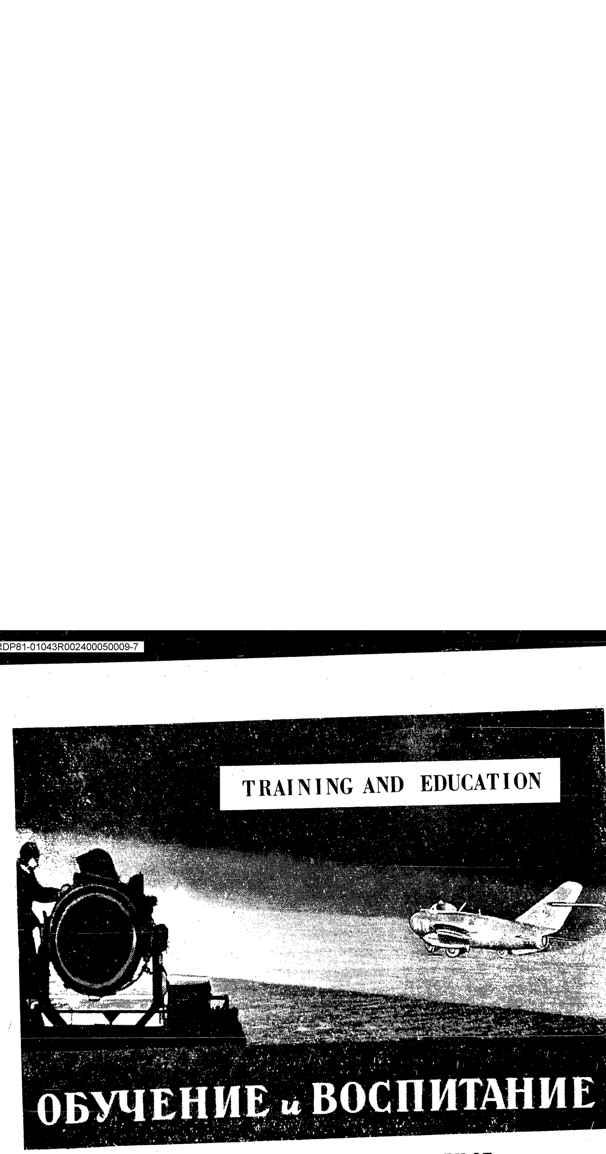
Thus, the combat capabilities of fighters, like the ability to carry out a specific combat mission of repulsing enemy aircraft raids, will be expressed by the function $\frac{CWKN_f}{P_n}$, with P_n % as the losses necessary for repulsing the enemy. Knowing the composition of a group of enemy aircraft, the number of active friendly fighters and the capabilities of one fighter, and the losses which it is necessary to inflict upon the enemy, it is possible to determine the number of fighters necessary for carrying out a specific combat mission $N_{f.n} = \frac{N_e \cdot P_n}{CWK}$, where $N_{f.n}$ is the number of fighters necessary for carrying out a combat mission, and where N_e is the composition of the enemy group.

Let us determine the combat capabilities of a fighter element in repulsing a bomber raid, if the capability of each of them in the destruction of aircraft of a given type corresponds to a value equal, for example, to 0.9. Let us take the number of active fighters in the element as equal to three, i.e., out of four fighters three fire directly at the target. Let us assume that in order to repulse the raid it is necessary to destroy 50% of the bombers.

On the basis of the aforementioned formula we get combat capabilities of the element $\frac{0.9 \cdot 0.56 \cdot 0.75 \cdot 4}{0.5} = 3$. This means that the fighter element under the given conditions is able to repulse a group of bombers composed of three aircraft.

Consequently, if one takes the mean values of such quantities as the number of attacks, the amount of bursts per attack, the range and angle-off of fire, the percentage of aircraft destruction necessary to disrupt the enemy's combat mission for a definite group composition of friendly fighters and enemy aircraft, then it is possible to determine the mean values of their combat capabilities in carrying out specific missions. These data may be taken as tactical norms for planning the combat operations of fighters. At the same time, of course, the morale, combat qualities and experience of the flight personnel should not be neglected.

Thus, the proposed method for determining the combat capabilities of fighters permits taking into consideration, besides firing capabilities, such an important factor as the correlation of aircraft flight and tactical characteristics, and consequently, permits a more exact determination of the anticipated result of fighter operations.



THE MORAL MAKE-UP OF THE SOVIET PILOT

Lt. Col. I. I. Sushin

V. I. Lenin, the founder of the Communist Party, the Soviet State, and its Armed Forces, taught that in every war victory depends to a large degree on the moral staunchness of the troops. Under modern conditions, at a time when the imperialistic aggressors are preparing intensively for war with the use of atomic weapons and other means of mass destruction, the role of the moral factor has increased even more. The Minister of Defense, Marshal of the Soviet Union G. K. Zhukov, while delivering a speech at the All-Army Conference of Outstanding Men, said emphatically: "No matter what powerful weapons armies possess, the decisive role in achieving victory over the enemy belongs to the people who have high moral and combat qualities, and who know how to apply the entire strength of weapons and equipment."

And who is to implant such qualities in the men? First of all, the officer personnel. The body of officers is the skeleton of the army, which holds together the troops as one disciplined military organism.

In the Air Force every pilot, while being an air fighter, is at the same time a commander. He is responsible for the training and education of the personnel of the crew, sub-unit, or unit. Successful solution of all the problems depends on his political maturity, his military and technical culture, and his ability for organization. That is why our officers above all must themselves possess high moral and combat qualities. Such qualities are implanted in them by the Communist Party and the Soviet Government, which are constantly concerned with strengthening our valiant Armed Forces and their most important component — military aviation.

The Soviet officer has devoted his life to the glorious military profession, which is respected in our country and which demands from him definite moral and combat

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/10/31 : CIA-RDP81-01043R002400050009-7

qualities. Their aggregate is what we call the moral make-up of a Soviet officer.

Such qualities as a high ideology, a deep devotion to the cause of Communism, an ardent love for their socialist Motherland and a burning hatred for its enemies, a Communist attitude toward labor and its results — socialist property, collectivism, humanitarianism, and strict observance of the rules of a socialist community — are inherent in the Soviet people who have been brought up in a Communist spirit by our Party. These remarkable moral qualities, typical of Soviet man, are being developed in him on the basis of a progressive social and state system with its new socialistic relations among people.

The noble moral qualities inculcated by the Party in the Soviet people are embodied in full measure in its faithful sons — the officers of the Armed Forces.

Selfless devotion to his socialist Motherland and unquenchable hatred for its enemies are the main features of the moral make-up of the Soviet officer.

Our officer is an ardent patriot. He is proud to be entrusted with the defense of the most just social and state system in the world, and of the great cause of building Communism. It is exactly this Soviet patriotism which was the powerful source of the mass heroism displayed by the personnel of our Army, Air Force, and Navy in the difficult years of the Great Patriotic War.

This feeling drove N. F. Gastello to direct his burning bomber at a column of enemy tanks; it gave strength to A. P. Mares'yev, to L. G. Belousov, and Z. A. Sorokin to return to the ranks of combat pilots even after they had lost their legs; it inspired M. P. Devyatayev and his comrades to continue their courageous struggle with the enemy under the hard conditions of captivity and to accomplish their bold flight home on an aircraft captured from the Hitlerites.

The many thousands, many millions of heroes who bravely defended their native land in times of severe trial in the last war showed the greatest devotion to their Fatherland.

It is typical of officers in capitalistic armies that the choice of military service, for the overwhelming majority, is dictated not by patriotism at all but by career and business interests. Brought up in the spirit of bourgeois morality they place material interests above everything. American flyer Donald S. Searman, whose plane was brought down in the Korean war, frankly declared: "I became a pilot because it pays well."

Such indifference toward one's native land is typical of the American Armed Forces — not only in individual cases. In connection with this, an article published in the American magazine "Liberty" under the curious title "Aren't Americans Cowards?" is very characteristic. The author of the article, William Bradford Huie, analyzing the facts which showed how the Americans avoided military service and fighting at the front during WW II, informs us that 10% of all the commissioned officers of the U. S. Army were court-marshalled during the war for avoiding participation in battle, and that 4000 commissioned officers dodged combat by inflicting injuries on themselves. In conclusion, Huie writes: "If you sum up the total of all 'psychos', 'cowards', 'parasites' and those who 'do not care', then, according to the most cautious calculations, you will have to admit that at least four million physically healthy Americans of military age turned out to be either incapable or unwilling to fight for their native country during WW II."

The Soviet soldier is ready to give his life for his Motherland. While in wartime the Soviet officer's patriotism has shown itself in a selfless struggle against the enemy, in peacetime his patriotism is seen in his concern for strengthening the combat preparedness of his sub-unit and his unit, in preparing Outstanding Men in combat and political training, in persistent striving to attain the honorable title of Outstanding Man.

The Soviet patriot combines an ardent love for his Motherland with an unquenchable hatred for its enemies. Is it not a legitimate hatred that arises in each one of us when we see how brazenly the American imperialists and their accomplices act against the Soviet Union and against all peace-loving countries? Can there be anything but indignation when we see them openly appropriating hundreds of millions of dollars for "secret war" against the countries of the socialist camp, organizing espionage, diversions, and even armed provocations? But our hatred for the predatory imperialists has nothing in common with the animal hatred cultivated in the bourgeois armies. There they try to waken beastly instincts in men and officers, making ravishers and killers of them and preaching to them their racial superiority over other nations. An ideology of racial hatred toward men is alien to us. We are internationalists. We do not and cannot have hatred toward other nations, but we do hate those who oppress and exploit the workers, those who are enemies of freedom and progress, and those who cherish a delirious hope of establishing their supremacy over the whole world.

Hatred toward enemies is not an abstract emotion. During times of military stress it demands from the Soviet officer the achievement of victory over the enemy even at the cost of his life. During the past war our pilots, too, fought against their enemies to the death.

On 22 June 1941, Komsomol member, Flight Commander Junior Lt. L. G. Butelin took off for a combat mission. He attacked Hitlerite troops and waged aerial combat until his ammunition gave out. On his return he met a Fascist Ju-88 bomber near our airfield. Leonid Butelin boldly rushed to the attack and rammed the enemy aircraft with the propeller of his fighting machine. This took place at 0515. Butelin died a hero's death but destroyed the Fascist pirate. Thus, at the very beginning of the Great Patriotic War an air ramming was accomplished. On the same day around 1000, yet another Soviet pilot, Peter Ryabtsev, executed a ramming near Brest.

Only exceptionally courageous pilots are capable of such exploits, pilots who deeply realize their personal responsibility for the cause of their Motherland's protection and who hate their enemies mortally.

In time of peace the soldiers' hatred for the enemies shows itself in a high revolutionary vigilance.

What does it mean for an officer to be vigilant?

It means to fulfill unflinchingly all the demands of the oath and the regulations on keeping State and military secrets, to observe strictly the procedure established for keeping documents. It means being scrupulous in the choice of acquaintances and of places for relaxation and entertainment, not talking too much when at work and even less when not at work. But the most important thing is to organize the life of a unit or outfit so as to achieve a high degree of constant combat readiness. The way to achieve this is to maintain strict order and iron discipline.

Discipline is the basis of the combat readiness and fighting efficiency of troops in peacetime, it is the mother of victory in wartime. Discipline is one of the most necessary moral and combat qualities of an officer. Guards Capt. G. P. Maslovskiy, a Communist and a hero of the Great Patriotic War, stated this remarkably in a letter to his son just before he died: "...Well, my dear son, we won't see each other anymore. An hour ago, I received from the division commander an assignment from which I shall not return alive. Don't be afraid of this, my lad, and don't lose heart. Be as proud as your daddy is in going to his death, because not everyone is permitted to die for his Motherland...

"Lenin's glorious city — the cradle of the Revolution — is in danger. Its future welfare depends on the fulfilment of my mission. For the sake of this great good I shall carry out my mission to my last breath, to the last drop of my blood. I have no intention of refusing such a mission; on the contrary, I am burning with the desire to accomplish it as soon as possible.

"...What is the power that helps to accomplish such a heroic deed?" — asks Maslovskiy. And he answers:

"Military discipline and obedience to the Party. It is true what they say: there is only one step from discipline to heroism. Keep this in your mind, son, once and for all...I am telling you about everything in detail, because I want you to know what kind of a person your father was, what he gave his life for and how. When you grow up, you will understand, you will care for your Motherland. It is good, it is very good to cherish one's Motherland!..."

A pilot needs strict discipline not only during war or flying. Discipline is indispensable everywhere.

Lack of discipline is a sign of a person's weak will. He who has a strong will always controls his actions wisely. A strong-willed officer is notable not only for his high discipline but also for his presence of mind in a difficult situation. It is when exposed to danger that he shows audacity, courage, and valor.

Courage is the ability to overcome fear, to subordinate fear to sense of duty; it is a willingness to give, if necessary, one's life for one's Motherland. V. I. Lenin used to say that courage and daring, the absence of fear in battle, and willingness to fight together with one's people against the enemy must constitute the basic qualities of the Soviet people.

Cowards do not conquer. We despise cowards. Cowardice is akin to panic, and panic inevitably leads to defeat. But courage increases a man's strength tenfold. Hundreds and thousands of courageous men, brave champions of the Soviet skies, are nurtured in our Air Force. The name of pilot A. K. Gorovets — a Communist and Hero of the Soviet Union — occupies an honorable place among those of legendary heroes who are the pride of the Soviet people. All by himself he engaged in combat against a group of enemy aircraft and managed to destroy nine German bombers!

A pilot can be a hero in peacetime too! Here is one of many excellent examples of serving one's country well. Col. F. F. Opadchiy has been working in the Air Force for 27 years, of these more than 20 as a test pilot. His willpower, courage, and skill helped him more than once to acquit himself with honor in the most difficult situation. Quite recently pilot Opadchiy was awarded the title of Hero of the Soviet Union for his courage and resourcefulness shown in testing new planes.

The soldier is an armed defender of his Motherland. Consequently, he is regard-

Photo: Capt. I. G. Shkondin

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/10/31 : CIA-RDP81-01043R002400050009-7

ed first of all as an expert in military affairs. In aviation, the success of the battle depends on the skill and initiative of the pilot, who at the same time is a soldier. As is known, a pilot's skill is made up of an irreproachable knowledge of aviation equipment and the ability to use it under any conditions. It is not necessary to prove that superficial knowledge or careless application of the rules for use of equipment cannot be tolerated. Aircraft equipment is a mighty force, but only in the hands of a skillful soldier.

The enormous advantage of the Soviet army over bourgeois armied lies in the fact that its personnel is brought up in the spirit of socialist collectivism. In military circles this spirit manifests itself in combat friendship and camaraderie among the troops. These remarkable qualities of the personnel of our army, a new type of army, are based on the moral and political unity of Soviet society and on the indestructible friendship among the peoples of the Soviet country.

What does it mean for our soldier to be a true comrade and friend? The answer to this question is given in the Regulations of the Internal Service, which demand that every serviceman "assist his comrades by word and deed, restrain them from untoward actions, and help them out in times of crisis without regard for personal safety."

Mutual help and support in combat: these are the main signs of true friendship. Soviet officers have risked their lives to save their comrades who were facing difficulties. Many such feats could be mentioned.

Pilot and Communist Capt. I. G. Shkondin recently showed an exciting example of faithfulness to military camaraderie. During a flight mission a fire broke out on a heavy bomber. It was impossible to extinguish it. The navigator was severely burned and lost consciousness.

The commander ordered the crew to bail out. An incoming burst of air dispersed the smoke. Shkondin noticed that the navigator had not left the plane and was not able to do so. What was there to do? Save himself and abandon his comrade? No, Communists do not act this way. Capt. Shkondin made up his mind to land the burning plane on a field. Soldiers who happened to be near-by came running to the site of the emergency landing and quickly put out the fire. The comrade's life was saved.

Another indication of troop camaraderie is devotion to Communist principles. A true friend will not be indifferent to the errors and shortcomings of his comrade but will try to restrain him from any untoward actions which disgrace the honor of the outfit or unit, will help him correct shortcomings in his studies and behavior. He will not be afraid to tell his friend candidly of his faults and, if this does not help, he will criticize him sharply in public.

Socialist collectivism with its principle, "man is friend to man," is not to be separated from socialist humanism. Humanism, i.e., love of mankind, is one of the typical traits of the Soviet officer's moral make-up. This noble quality shows itself in respect for people, in tactfulness to subordinates, and in concern for them. How often our men and officers lovingly call their strict and demanding — but nevertheless just — superior "father"! With such a commander they will go through thick and thin.

A superior's respect for and humane treatment of his subordinates inspire the soldier to fulfill his duties even better. It was not without reason that M. I. Kalinin said in one of his speeches before a military audience: "If you have the opportunity to be a superior, then be not only a superior but also a friend to your subordinates."

The superior is the friend of his subordinates! This is possible only in the army of a socialist state. He who violates this principle in his relations to his subordinates, who is rude and insults their civil dignity, undermines his authority as a commander of the Soviet Armed Forces.

Very important moral qualities of the Soviet officer are also his truthfulness and honesty. Any deception on the part of the commander or of companions-in-arms even in peacetime, to say nothing about wartime, causes serious damage to the interests of the cause.

Think, for instance, about the relations between the pilot and the technician, or between the pilot and the mechanic. Is it not clear that the safety of the flight and sometimes even the crew's lives depend very much on the technician's or mechanic's honesty? Consequently, relations of mutual trust between them are necessary.

And what happens if a pilot begins to act against his conscience before his commander? For instance, a pilot makes a mistake, even though to him it seems a most insignificant one in the technique of piloting, but holds it back in his report to the commander about his operations in the air. It is clear that this error will not be corrected; but, repeated many times, it can become a harmful habit and may lead to a serious accident. Under conditions of war the pilot's untruthfulness can lead to the sacrifice of innocent victims.

More often than not, a soldier's untruthfulness can be explained by a feeling of false shame, by an unwillingness to place himself in an unfavorable light before his commander and his comrades. But who can say about himself that he has never been wrong? V. I. Lenin said that the intelligent person is not the one who makes no mistakes. There are not and can not be such people. Only he is intelligent who, having made a mistake, bravely admits it and is able to set it right.

The description of the moral make-up of the Soviet soldier will not be complete if nothing is said about his behavior in everyday life. With a healthy mode of living, normal family relations, and well-brought-up children, a man feels cheerful, has more energy, and works successfully. Without this a man is restless and nervous, all of which is reflected in his service activity.

Some officers still think that their behavior in everyday life is their private affair. It is not hard to understand how wrong and harmful such ideas are.

The main and decisive role in indoctrinating officers with high moral and combat qualities belongs to the commander. The Party and the government have made him wholly responsible for the combat readiness of the unit and the outfit, for the training and indoctrination of the personnel. It is in the process of training and indoctrination that the moral and combat qualities indispensable to the aviator are formed. The more a commander relies in his work upon the political apparatus, upon the Party and Komsomol organizations, the greater his success as a military leader and educator.

At one time M. I. Kalinin pointed out that the indoctrination of people, especially of military people, is a complicated and delicate affair. There is no prescription or pattern for it. Required of commanders is a consideration of the specific peculiarities of the situation and the problems to be solved, a tactful approach to the men, an ability to utilize all means and forms of indoctrination.

Let us take the organization of the work of indoctrinating officers under Air

Force Commander A. I. Sokolov. The commanders and political workers subordinated to him do their work not formally but with all their heart. First of all the officers go through the process of combat training. During flights the commanders do not tolerate any leniency or conventionality but try to create a setup very close to a combat situation.

To increase the sense of responsibility for carrying out official duties and to inculcate a conscientious attitude toward work, all forms and means of Party and political work are used: lectures, group and individual discussions, meetings, theoretical discussions, the press, visual propaganda, and mass-cultural projects.

In the work of the ideological and political indoctrination of the officers, the leader personnel takes an active part. Thus, to assist officers studying Marxist-Leninist doctrine on war and the army, comrade A. I. Sokolov delivered a lecture on the subject: "The role of V. I. Lenin in the creation of the Soviet Armed Forces"; officer D. I. Lyapinkov delivered a lecture on "Soviet military science and its advantages over bourgeois military science," etc. Our leader officers do not avoid contact with their subordinates in off-duty hours. This brings them closer to the mass of officers, and gives the officers an opportunity to speak freely about everything that worries them and to get advice from their older comrades who have more experience in aviation and in everyday life. Unfortunately, one cannot say that all our commanders have already appreciated the importance and the necessity of contact with their subordinates in off-duty hours.

The experience of the commander and political workers in working with the young officers deserves attention. Recently the command, together with the most active members of the Party, organized a check on and a study of the work with young officers. It turned out that here and there little work had been done with the young people, that they had not always been helped in integrating themselves into the ranks of combat pilots fast enough, the proper concern had not been given them in arranging their everyday life. The results of the check were discussed with the leader officer personnel, and measures were taken to correct the shortcomings revealed. The young officers were inspired with hope, their mood became better, and discipline improved.

In the Soviet Armed Forces great and honorable tasks are entrusted to Party organizations. Their first and foremost duty is: indoctrinating Communists in the spirit of the ideas of Marxism-Leninism, of irreconcilability with shortcomings; ensuring that Party members and candidates set a personal example in combat training and discipline, in observance of the military oath and in carrying out the requirements of military regulations and orders; comprehensive strengthening of one-man control and authority of the commanders. But the role of Army and Party organizations is not limited to this alone. They are obliged to guide the Komsomol organizations constantly, to take care of the political and military training of the members of VLKSM [All-Union Leninist Young Communist League]. At the same time, as the "Instructions to the CPSU Organizations in the Soviet Army and Navy" emphasize, they have to know all the needs and temperaments of all the personnel, to try to understand all aspects of life in the unit, to assist the commander and his political deputy in solving the problems of political and military training of the personnel, and to popularize the experience of outstanding officers, sergeants, and men.

To instill high moral and combat qualities in the officers means first and foremost to raise their ideological-theoretical level. A person's behavior depends after all on his convictions. The high ideals of the Soviet officer, his profound conviction of the righteousness and invincibility of the Party's great cause — Communism — these are what determine the noble traits of his moral make-up.

These Communist convictions of the officer manifest themselves in his ability to evaluate the phenomena and events of social life, the activities and actions of the people around him and of himself from the standpoint of the Party. Such ability is developed by studying Marxism-Leninism.

Studying Marxism-Leninism thoroughly, our officers not only enrich themselves ideologically but also master the true scientific method, which permits them to do their practical work successfully. It is impossible to master Soviet military science to perfection without mastering Marxist-Leninist theory, and without this one cannot become a valuable military specialist.

While explaining daily the wise policy of the Communist Party to all officers and men and showing them the progress in building Communism achieved in 40 years of Soviet rule under the leadership of the Party, the commanders, political workers, and Party and Komsomol organizations develop in them a pride in their mighty socialist Motherland and increase their sense of personal responsibility for defending its state interests.

The constant combat readiness of Soviet officers serves as the basic criterion for the conscientious performance of their official duties. It is necessary to increase their military knowledge continuously, to strive for perfect mastery of the newest combat equipment, of all ways and methods of conducting modern warfare and methods of training subordinates.

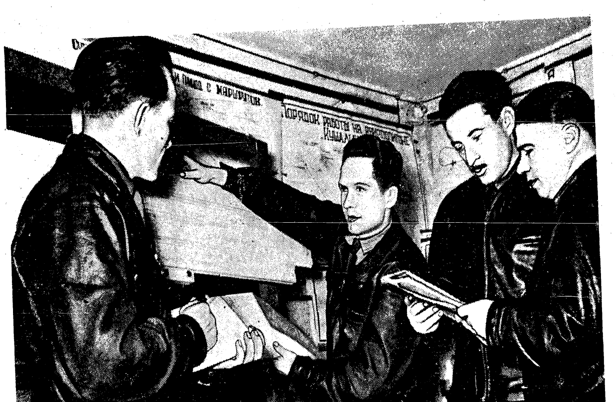
The leading principle in the training and indoctrination of officer cadres, as of all the men, is to teach the troops everything that is necessary during a war.

The heroic history of our Armed Forces offers very rich material for the training and indoctrination of our officer cadres. Lectures and discussions about the combat traditions of the Soviet Army, of one's own unit or group, meetings of the young officers with the unit's veterans, with participants in the Great Patriotic War, with Heroes of the Soviet Union, and with Heroes of Socialist Labor — all these and many other things are an effective form of patriotic indoctrination of the soldiers. All the time, more and more new names are being added to the annals of the Soviet Air Force; these are the names of people whose loyal service to their socialist Motherland have earned nationwide recognition.

These are the names of outstanding test pilots: Yu. A. Antipov, S. M. Antonov, D. V. Gaponenko, V. G. Ivanov, N. A. Korovin, N. I. Korovushkin, V. S. Kotlov, L. M. Kuvshinov, V. G. Romanyuk, A. V. Sarigin, and A. K. Starikov.

The life stories of these famous pilots who have tested hundreds of aircraft are worthy examples for young aviators. It is from the veterans that the young people have to learn selflessness in fulfilling their military duty, heroism and endurance, self-control and resourcefulness, precise skill, and readiness to overcome the most difficult obstacles on the way to the goal assigned.

Comprehensive improvement in the work of commanders, political organs, Party and Komsomol organizations in ideological political and military training of the officer personnel is the key to the further progress of combat readiness.



In the photo: Military Navigator First Class Capt. A. Vorontsov (first on the left) conducting a class with navigators.

Photo: Yu. Skuratov

FORTY YEARS IN THE RANKS

S. A. Krasovskiy (1921)

News about the victory of the October Socialist Revolution spreading quickly all over the country reached the front. The news was received joyfully by S. A. Krasovskiy, a young Belorussian peasant dressed in a soldier's greatcoat. Even after the February Revolution he had felt and understood that the Bolshevik slogans were nearest and dearest to him. Now he immediately took the proletariat's side and took an active part in the struggle for strengthening the Soviet regime. He was elected chairman of the soldiers' committee of the 25th Corps air detachment. Soon Stepan Akimovich joined the ranks of the Red Guards and, with weapon in hand, participated in the battles against the German invaders who were trying to smother the young Soviet republic.

After February 1918 S. A. Krasovskiy, in different air detachments of the Workers' and Peasants' Red Army,

Hero of the Soviet Union
Col. Gen. of the Air Force
S. A. Krasovskiy

participated in battles on the Eastern front, at Astrakhan' and Tsaritsyn, and in the Caucasus; he headed Communist groups in the struggle with the counter-revolutionary rebellions of the kulaks. As an active and fighting member of the Communist Party (he was accepted in its ranks in August 1918) in 1920 S. A. Krasovskiy was appointed military commissar of the detachment and later commissar of the Field HQ of the Air Force of the Eleventh Army on the Caucasian front.

After the Civil War Stepan Akimovich improved his military knowledge, completed the higher academic courses for the improvement of Air Force command cadres, and later graduated from the operations department of the VVA [Air Force Academy]. He held a series of command posts — from squadron commander to commander of an Air Force district. S. A. Krasovskiy applied all his knowledge and energy to the training and indoctrination of the personnel and strove resolutely for its high combat readiness.

Then the Great Patriotic War started. General S. A. Krasovskiy was one of those who went through both the bitterness of failure in the first year of the Hitlerite invasion and the joy of victory over the Fascist barbarians. In the fall of 1941, as Air Force commander of the 56th Army, he organized combat activities of the air units at Rostov. Stalingrad, Voronezh, the Kursk bulge, Kiyev, L'vov, the Oder River, Berlin, Prague — these are the places where the pilots of the Air Force fought under the command of Gen. Krasovskiy, one of the most talented Air Force commanders, destroying the enemy's aviation in the air and delivering powerful blows at his ground forces. Their contribution to the crushing of Hitlerite Germany was highly valued. The personnel of this Army received more than 35 commendations from the Supreme Commander-in-Chief for their participation in the liberation of cities and large settlements and for surrounding and eliminating large forces of the enemy. Many units and formations were decorated, scores of pilots were honored with the lofty title of "Hero of the Soviet Union", and thousands received orders and medals.

The awarding to Col. Gen. S. A. Krasovskiy of the title of "Hero of the Soviet Union", three Orders of Lenin, three Orders of the Red Banner, orders of Suvorov Second Class and of Bogdan Khmelnitskiy First Class, and of the Red Star is a recognition of his valor and military talent. S. A. Krasovskiy also received the Czechoslovak order of the "White Lion" and the Polish cross "Grunwald First Class."

Col. Gen. of the Air Force Stepan Akimovich Krasovskiy is 60 years old. All his rich experience accumulated in forty years of service in the Soviet Army and Air Force, in battles against the enemies of our Motherland he now gives to the training and indoctrination of aviation cadres.

READYING FIGHTERS FOR NIGHT OPERATIONS

Military Pilot First Class, Col. Ye. V. Sukhorukov

1. Landing of a Fighter Aircraft at Night With the Aid of a Landing Light

It is far from being always possible under combat conditions to bring in an aircraft at night, fully utilizing airfield lighting equipment, since an illuminated airfield will be visible from a distance of dozens of kilometers on a cloudless night. Landing on an airfield whose landing-area floodlights are in operation, with the runway brightly lit, with its approach lights and light beacon on, is of course much easier than landing on a blacked-out airfield.

The aircraft landing light enables the pilot to be independent of ground sources of light. In this lies the tremendous advantage of landing with the aid of a landing light.

We can borrow an example from our transport aviation. It is common knowledge that such landings have received widespread acceptance there. On training and scheduled flights, on flights entailing landing at other airfields, the flying personnel of transport aircraft, as a rule, makes landings solely with the aid of a landing light, without the landing-area floodlights switched on.

Transport aircraft are equipped with a more powerful lighting system and the landing technique itself is easier than it is in the case of a jet fighter aircraft. However, the experience of best fighter pilots with night training proves convincingly that, even though landing on an unilluminated runway can be successfully mastered, it can only be done in those outfits where the pilots undergo regular training, instead of confining themselves to using the landing light solely for additional illumination during taxiing and for designating their position in the air. Therefore pilots and officers who try to introduce this method into everyday practice must be encouraged in every way. The training must have a systematic, organized, and methodically well-thought out character.

Organization and operation of flights with the aid of a landing light does not require any additional expenditure of time or money. The training of the flying personnel in landing on a runway unilluminated by floodlights proceeds in the usual order, from the simple to the difficult. Flights are preceded by brief training on the ground. Techniques of making the approach and landing computation and, particularly, of landing on a blacked-out runway are studied in the classroom. During preliminary training, the flying personnel work out the sequence of operating the aircraft cabin equipment, become acquainted with the problems peculiar to course plotting, the approach and landing computation, and with special situations in flight.

Training in the air begins with flying in a circular pattern in a two-place aircraft accompanied by an instructor. At first the regular runway lighting is used, and later the brightness of the airfield lights is reduced until they are completely extinguished. From personal experience I can say that flying in a circular pattern at night is somewhat more difficult than it is during the day. The ground is not visible,

it is difficult to estimate the distance to light check points, and it is often necessary to fly the aircraft by instruments alone. Flying in a circular pattern and making a landing approach on a completely blacked-out airfield is even more complicated. The pilot cannot make use of light check points to plot his course. A landing approach can be performed more easily by instruments, making use of the landing system. To cut the time required and to make an accurate directional approach to the runway, it is better to approach it by making two 180° turns. In doing this the pilot ignores light points in the vicinity of the airfield; he orients himself entirely by the readings of the radio and magnetic compass, maintaining his position in space by the artificial horizon, the variometer, the speed and altitude indicators. The methods of approach are the same as those in usual instrument flight. Once the aircraft is on the landing course, however, and, later, after it approaches the homing radio station, certain peculiarities are encountered.

The fact is that in approaching the outer homing radio station the pilot already sees the approach lights and, later, the runway lights. Maintaining the heading under such conditions presents no difficulty. It is more complicated to estimate the distance to these lights and to make the necessary calculations for let-down from an altitude of 200-300 meters over the outer homing radio station.

The aircraft approaches the inner homing radio station at an altitude of 80-100 meters with a constant gliding speed. The point where rounding out commences, located at 400-500 meters from the runway, must be approached by the aircraft at an altitude of 7-8 meters. Being well acquainted with the altitude of these control points and their distance from the aircraft's touchdown position, the pilot makes a landing computation as if he were descending from step to step. If the pilot observes such a sequence, his computations will always be correct. The only correction he would have to make every time would be that for wind.

Such a sequence of operations is due to the fact that the distances between the homing radio station, the initial rounding-out point, and the point of touchdown permit a corresponding decrease of flight speed. Altitudes at which the stations are passed and at which the initial rounding out is made enables the aircraft to descend in a gradual glide with small vertical velocities at given engine rpm. Since rounding out begins at a definite distance from the runway, the aircraft touches down at a designated spot.

The procedure described above of computing the landing is the same both for day and night, when rounding out is planned and begun in the zone of obstruction lights or in the beam of the first floodlight.

However, the approach and computation for landing with a landing light are performed in a different manner. This is due first of all to the fact that it is harder for the pilot to keep track of the point of initiating the round-out, even though it is located on the level of the obstruction lights which are quite visible from the air. The area on which the aircraft must be landed is not illuminated; hence a certain tenseness on the part of the pilot.

I usually carry out landing with a landing light in the following sequence. Having passed the inner homing radio station at an altitude of 50-60 m, I switch on the light and while continuing the descent I begin to distinguish the illuminated spot on the ground, which becomes brighter as the aircraft approaches the ground. If the landing light is switched on too early the beam will not reach the ground and the surface will not be visible, while the light itself wears out considerably faster. In switching on the light later, the vision of the pilot has no time to adapt itself to following the illuminated surface of the earth and he may not have enough time to prepare for landing.

After the landing light is switched on, the glance is transferred in the direction of the beam to the ground. As the descent progresses, the illuminated spot becomes brighter, the ground is easier to discern. Now it must be determined whether the time has come to start rounding out. A glance at the altimeter will not give a precise answer, but rather will distract attention and can lead to an error. Consistency in computations, gained previously by the pilot, is of great importance. With correct computations the aircraft must approach the line of obstruction lights at an altitude of 7-10 meters. From this altitude the ground can already be quite clearly seen and the altitude is estimated visually. But the ground is perceived differently depending on whether the night is dark or light. On a dark night the ray of light is brighter, the surface stands out better, and is visible from a greater altitude; on a bright night, on the other hand, the beam is scattered, the ground is illuminated less brightly, and it may be harder to judge accurately the altitude of the initial round-out. Sometimes even when flying two or three nights in a row, difficulties are experienced in landing because one night differs so much from another. This is where experience and good training — which depend on the regularity of night flying under different conditions — come in handy.

In making a landing with flood lights, the pilot sees a white strip of uniformly illuminated ground. The glance travels along it and the sensations at this stage of landing are about the same as they are in the daytime. There is virtually no darkness in the field of vision. A different picture is presented in landing with a landing light. Its beam, picking out a limited area from the surrounding darkness, provides sufficient illumination for perceiving the surface, and it is possible to make a correct estimate of the aircraft's true altitude above the ground. But the illuminated spot moves with the aircraft, skims along the surface of the earth, and this in some measure distracts the attention and makes the landing more difficult. The duration of the process of the aircraft's rounding out and floating above the ground, up to the moment of touchdown, is short. As speed is decreased and the aircraft smoothly approaches the ground, one must look constantly in the direction of the beam. However, because of the increase in the aircraft's angle of attack, in the process of rounding out this beam rises, the illuminated spot on the ground and, consequently, the direction of the glance, advance, and this creates one of the difficulties.

After landing and the commencement of steady taxiing on the main and the front wheels, the landing light must be switched off in order to prevent premature discharge of the batteries. In general it must be remembered that landing illumination should be used while the engine is running, thus ensuring that the generator is cut in. In taxiing with landing illumination pilots sometimes forget about this. Instead of taxiing with a definite speed with corresponding engine rpm, they first speed up the aircraft by revving the engine, then later continue taxiing with rpm cut off. The landing light in such cases is fed by the energy of the batteries and rapidly discharges them.

The main thing required for successful landing with a landing light is to learn to judge the rounding-out altitude accurately. Errors committed in this case as a rule make the situation more difficult further on. Indeed, the aircraft descends rapidly, the attention of the pilot is divided between checking the correctness of his computation and the correct time for leveling out the aircraft. The ground is less clearly visible than during an approach to an area illuminated by floodlights, and definitely worse than it is during the day. Most often under these conditions pilots begin rounding out prematurely. An experienced pilot will notice this, but sometimes the landing ends with a rough touchdown.

In rounding out the aircraft at an altitude of less than 7 m, touchdown sometimes occurs at too high a speed simultaneously on the main and the front wheels.

In training flights, to facilitate the directional approach after the aircraft passes the outer homing radio station, the lights on the runway can be blinked a few times or switched on for a short time. The approach is also considerably facilitated by temporarily switching on several lights, making up a light line, and denoting the width of the runway. In the area where the round-out is started, light points must be installed of such brilliance as to permit the pilot to observe them from an altitude of 100 meters over the inner homing radio station. These lights are switched on when necessary, after the aircraft passes the outer homing radio station. In principle, it is possible to make the landing computation and to determine the place and altitude for starting the round-out by these light points.

Pilots with experience in night flying master without special difficulties the approach to and landing on a blacked-out runway with illumination provided only by the aircraft's landing light. Flights with the lights completely off on the airfield and on the approaches to it require great experience and continuous practice. With correct organization and training methods, with a gradual transition from the simple to the complicated, the flying personnel will successfully master flying at night under normal and adverse weather conditions.

Now a few remarks addressed to our designers. It is well known how important the location of the landing light on the aircraft is. However, it is located now on different types and even different series of aircraft of the same type in a different way: in the nose, under the left wing, and on the left side of the fuselage. There are stationary landing lights as well as those which are extended when switched on. Such variety is hardly dictated by any special requirements. It is desirable that the landing light on fighter aircraft of all types be in one place. It wouldn't be bad if the instruments, knobs, and toggle switches in the aircraft cockpit were always located in the same place. Pilots in the process of getting acquainted with equipment fly different aircraft, and are compelled every time to get used to a new location of instruments in the cockpit. Naturally it creates additional difficulties in night flying.

The direction of the landing-light beam in all cases and on all aircraft must be the same, since the pilot is always looking at the ground in the forward direction and at a definite angle to the direction of landing. The beam of the landing light must illuminate the ground during round-out for a distance of 20-40 m ahead of the aircraft. If the ground is illuminated closer to the aircraft or further from it, errors are unavoidable. Cases are known when the location of the landing light was so unfortunate that the beam illuminated only the air above the ground or created only a small illuminated spot on the ground, and that too far ahead of the aircraft.

It must be noted that the installation of a landing light so far has not created the best conditions under which the pilot could make a landing with those modern aircraft whose descent in a glide path takes place with the front of the fuselage raised to a high position.

I would also like to express my opinion on what seems to me an important question.

2. Flying in a Pair and in an Element on a Bright Night

Flying fighter aircraft on a bright night is a rather complicated form of flight training. Usually the pilot, before undertaking night flying, is put through a long and hard training course. At first he gains practical habits in flying an aircraft on instruments in a closed cockpit and under adverse weather conditions by day and, later, by night.

I must at this point explain that I speak of flights of a fighter pair or element only on a bright night; since on a dark night, when visibility and search are rather difficult and the target can actually only be located by aircraft equipped with radar devices, the aircraft are flown on instruments. On a dark night the pilot doesn't see well. He can spot another aircraft only when the latter is distinguished by air navigation lights. The silhouette, the shadow, and the contrail are completely unnoticeable under these conditions. Furthermore, one cannot divert one's attention for long from the instruments for the purpose of visual observation and target search.

Flights of a fighter pair or element on a bright night are quite feasible. They are difficult, it's true; but they give the pilots good training under difficult conditions and can have rather extensive combat application.

Recently I had an occasion to become acquainted with the organization of flight training in unit X. They fly on prescribed route, at night in pairs only. Flying is necessarily done over water and over terrain unmarked by checkpoints far from populated areas. Under such conditions the commanders quite justifiably think that flying in pairs is less dangerous since the pilots can help each other when the necessity arises. The availability of two radio compasses considerably improves orientation, instills confidence in the pilots, and insures reliable navigation.

Besides, it should be clear to everyone that the combat application of fighter groups at night is also of practical importance. In taking off in groups, it is possible to concentrate a large number of aircraft in night patrol zones. Further employment of groups will give a considerable advantage in comparison with operations by single fighters.

If aerial combat at day and at night are compared, it is easy to notice how much more difficult the conditions of night combat are. In the day the enemy is spotted at a greater distance, can be seen well, and can be attacked until completely destroyed. There are enough forces present to effect total destruction of the target, since it is attacked by at least a pair of fighters.

The picture is different at night. The target is spotted not at a great distance, the visibility is poor, the attack maneuver is limited. The combat is itself brief: most often only one attack is made. When the target maneuvers — or when the pilot interrupts observation — it is easily lost.

Thus the target can be hit with certainty only by a successive introduction into the combat of several fighters. In introducing the fighters one by one into the combat the action against the enemy will be extended over a considerable time, and vectoring to the target must be effected anew every time. If, on the other hand, a pair or an element of fighters is vectored to the target, a greater effect may be achieved. Upon spotting the target, the pilots attack it in succession; then each one returns to his base or to his patrol zone by himself.

On a bright night the following variant of the combat employment of fighters is possible when the leader is an aircraft equipped with a radar sight. After the group is vectored to the target and closes with it, the actions of the leader (group leader) facilitate spotting the enemy.

Great possibilities are offered by the inclusion in the makeup of a group of fighters of aircraft which carry flare bombs. After the group is vectored to the target by ground radar, or better yet, upon the target's detection by fighters, the carriers of SAB [illuminating aerial bombs] illuminate the target, while the others attack it one by one.

Sometimes, especially at low altitudes, an aircraft can find itself in a zone of weak reception of ground radio stations. Control is disrupted. In such a case it is also advantageous to send out a fighter pair. Before the onset of unreliable communications they fly together, then one of them climbs and repeats the commands as a relay station for the ground radio station in vectoring the fighter to the target.

From the above discussion, it can be seen that combat employment of fighter groups on a bright night has great possibilities and can lead to real successes in a specific situation.

What are the ways and methods of practical training of flying personnel for such flights? I will refer to the experience of the same unit X. Pilots who have experience in independent night flying are trained in night flying in a pair or in an element. Training begins with flying in a pair in which the leader is followed by a two-place aircraft. The instructor demonstrates techniques of closure, of formating on the leader, of keeping the given distances and intervals. The pilot masters the control of the aircraft under conditions of horizontal flight, climbing, descent, and executing turns.

Later the training is continued in a combat aircraft. At first the instructor is the leader and the trainee is the wingman. They take off singly. It is best to take up formation on a straight leg before the first turn at an altitude of 600-700 m. This is simpler and safer than taking up formation on a leg between the second and the third turns, because the wingman does not execute turns and is not distracted by the necessity of searching for the leader.

At first it seems very difficult to fly the plane so as to keep the leader in the field of vision and to formate on him. During first flights, the pilots make mistakes. In trying to close in on the leader as fast as possible they accelerate the aircraft and experience difficulties in taking up formation. The leaders also act incorrectly when they make the first turn early (at an altitude of 200-300 meters), without giving the wingman a chance to take up his position in formation in a normal way. Upon seeing the leader turn, the wingman also begins to turn while still at a lower altitude, and cuts across the flight route. The attention of the pilot is directed at the leader in order not to lose him from view. At low altitudes such actions are dangerous, even for very experienced pilots.

All flying is done with air navigation lights switched on. On some aircraft the brightness of the air navigation lights can be regulated. Depending on the visibility and night conditions the pilots select the most convenient intensity (on a bright night they use the greatest brightness, on a dark night the least).

Illumination of the cockpit is also of great importance. Flying in pair or element when the cockpit is brightly lit is generally impossible since the space beyond it is very hard to see through. The best way is to observe the leader when the wingman's cockpit is completely dark. But this is not permissible since the pilot must clearly see the instruments. Therefore the most acceptable alternative is to fly with the instrument lighting bulbs switched to minimum brightness.

Other light interference is observed in flight — for instance, light reflections on the glass of the cockpit canopy. The pilot's scanning of the space outside and observing the lead plane is adversely affected by signal lamps and illumination of the instrument dials.

The training should be conducted on a bright night when the horizon is clearly visible. This facilitates navigation of the aircraft by the wingman, since in addition to the horizon and the air navigation lights he also sees the silhouette of the lead plane against the background of the sky.

It is hard to judge the distance to a point of light at night. Therefore, in first flights, distance and interval are kept somewhat greater (80-100 meters). This facilitates formation; and any deviations in keeping distances to the lead plane do not imperil the safety of the flight. In addition to observing the leader, the pilot can observe the horizon and the instruments to aid him in keeping distance. Collision is precluded since the distance between the aircraft is sufficiently great.

In the first stage of training, as is shown by experience, the most difficult thing is formating on the leader. Taking up formation should not be done with great excess speed; one should not be precisly on the tail of the leader, or deviate any distance to the side. Closure in this case takes more time, but there is sufficient time for its execution before the first turn at an altitude of 600-700 m. The leader climbs with prescribed forward and vertical speeds, gives commands to commence the turn, and carries out the turn with a 20-30° bank. Taking up formation is facilitated if the wingman knows the speed and flight course of the leader. Such information is obtained on the ground or is requested from the leader by radio.

The training usually begins with working out flights in the right bearing. The wingman, located to the rear and on the right keeps somewhat below, which makes it easier for him to see the leader against the background of the lighter sky. Flying with the wingman above is not possible, since the leader is not as easily visible and is easily lost.

Conditions for flight on a moonlit night are best, since the aircraft are easily visible in formation.

The pilot practices in keeping prescribed distances and intervals even before the commencement of flights. Aircraft are positioned on the ground at prescribed distances. Pilots climb into cockpits and memorize how the aircraft look in relation to each other. They must remember what position and dimensions the aircraft has on the glass of the cockpit canopy. Sometimes the position is outlined by colored lines. By keeping the lead plane within the borders of these lines, distance and interval are easily maintained.

The training takes place not only in the day but also in darkness. The pilot memorizes distances, gets used to orientation by air navigation lights. It is recommended that the training be repeated and be always given after a lapse in formation flying.

In later flights it is better to take off in pairs. For pilots who take off in pairs by day and who regularly fly by night this presents no additional difficulties. Distance and interval are more easily kept when they are equal to 2-3 times the length of the fuselage and the span of the aircraft.

The leader maintains accurate heading on the takeoff run, beginning the run without sudden release of brakes at high engine rpm. Takeoff in pairs in contrast to taking off singly, should be somewhat prolonged. This makes it easier for the wingman to keep his position during the run. After lift-off, while climbing, the leader keeps a prescribed flight regime and flies the aircraft on instruments. The wingman both flies the aircraft and keeps his distance by observing the leader.

In practice it is more convenient to maintain formation when the distance is somewhat greater and the interval somewhat smaller. The wingman in such a case, in addition to the air navigation lights, also sees the glow of the lead plane's exhaust nozzle. Formating on and taking up his position are the hardest points for the wingman to master. In our opinion, existing recommendations on the procedures for formating on the leader are not the best. They recommend that the wingmen, starting from afar, approach from the direction of their bearing to a prescribed distance and then, by a smooth closure, establish the required interval. In this connection, the wingman must move sideways in the direction of the lead plane — which is not without its dangers even in the daytime.

Considerably easier and safer is the procedure of closing in almost on the leader's tail, being somewhat below him and to the side.

If the interval is increased excessively, it is better to continue the flight in the established position. If it must be decreased, however, the aircraft must pull back somewhat, shorten the interval, come up to the required distance, and then, by moving outward, take up the required interval. Engine revolutions must be controlled smoothly without a sharp increase or decrease of thrust.

Closure or change of formation should under no circumstances be attempted when the leader is executing a turn. Closure and formating on are only executed on the straight leg during a climb or in horizontal flight.

Sometimes it is necessary to continue the flight with extinguished air navigation lights. These are the most difficult conditions. It goes without saying that such a flight on a dark night is actually impossible in an aircraft without special equipment. On a bright night, by observing the lead plane, the wingman can continue flying in formation. His approach in the direction of the target and his spotting of the target depend on the actions of the leader.

On the flight route or in the patrol zone orientation is mainly effected by the leader. He resets the radio compass to the frequency of the turning point or the point of destination, and keeps track of the light check points on the ground. The wingman carries out the entire flight with the radio compass set to the frequency of the airfield from which he took off, keeps track of the aircraft's position by instruments, and carries out overall orientation.

Night flights of an element can be made in close pairs. Distances between these must be great enough to enable the leader of the pair to observe the air and to maneuver. Breakup of the group for landing is carried out in the same way as it is during the day, over the flight line, but without any sharp peeloff. Approaches and landings are made only singly in all cases. Despite considerable difficulties, night flying under adverse weather conditions is not impossible. After takeoff the pair penetrates the cloud base in tight formation and flies on the flight route. Interception is done on a bright or moonlit night after the aircraft is vectored to the target area by ground radar in order that the search and closing in on the target be carried on behind the cloud cover until the target is spotted visually.

Penetrating the cloud cover in a pair is complicated, but no more difficult than it is in the daytime. The fact is that in the daytime, in flying in tight formation, the pilot sees the lead plane, and this makes his flying easier. If the wingman falls back of the leader or moves off to one side, he rapidly loses him. Then the wingman peels off and continues penetrating the cloud cover independently, flying on instruments alone. Transition to instrument observation presents certain difficulties and cannot be mastered by all pilots right away.

At night, the wingman does not see the configuration of the lead plane, but orients himself as to his position in space only by the leader's air navigation lights. This is entirely sufficient for safe aircraft piloting.

Indisputably, mastery of the technique of flying in a pair and in an element on a bright night is necessary for fighter pilots. The endurance, fearlessness, and initiative which are inculcated in the flight personnel are well worth the intensive effort expended in the period of training.

SOME SPECIAL FEATURES OF AIR NAVIGATION IN NIGHT FLYING

Military Navigator First Class, Guards Lt. Col. N. P. Nepomnyashchiy

One of the navigators of our group was assigned the mission of bombing a non-illuminated target. The approach to the bomb run had to be made not by homing radio station but by corner reflectors. The navigator, by means of the PSBN-m, [course-line computing sight], picked up the radar blips, brought the aircraft onto the bomb run, sighted, and released the bomb which fell...far from the target.

What had happened? Is it possible that the navigator's errors in his computations were so large? No. The reason was altogether different. The primary cause of the gross error in bombing was inaccuracy in piloting. The pilot had deviated somewhat from the required course, and the navigator did not notice it because he had not studied the area of the target sufficiently. The target blips had actually not been picked up (the target had passed by on the side, beyond the effective range of the radar sight), and similar blips of objects lying in the flight path of the aircraft had been mistaken for the target. The navigator's main error was that he had used only the PSBN for navigation on the last leg of the flight route before the target and had neglected other facilities. In this connection, it is not irrelevant to repeat the first and most fundamental rule: air navigation under any conditions, and particularly at night, should be effected by the combined use (actively) of the compass and the watch, utilizing electronic facilities as well as navigational computing instruments.

In night flying the navigator must work under conditions of artificial lighting in the cabin, which is very difficult. Therefore all his actions must be more accurate and more deliberate. Sometimes certain instrument controls must be operated by touch, "blindly". For an experienced navigator this is no problem. But the inexperienced must gradually develop habits in operating the instruments under conditions of artificial lighting in the cabin in order to operate in night flying just as accurately and confidently as in daytime flying.

When a flight is made in daytime, the navigator, even in bad weather, can usually check the map with the locality, through "windows" in the clouds, for example. At night, especially on dark nights, in the absence of any light check points (which is typical of combat conditions), such a possibility is excluded. This means that all attention must be concentrated on utilization of instrument and electronic navigational facilities, using them, as already mentioned, in combination.

During twilight flights, because of the so-called "night effect", it is very difficult to use the radio compass and ground direction finders operating on short wave. This effect is sometimes so strong that, for example, the radio compass begins functioning late at a distance from the radio station 3-4 times less than is usually the case. Sometimes even through the crackling and noise in the earphones the call signs of the radio station can be heard quite well, but the needle of the ARK [automatic radio compass] does not give the required reading. In consideration of this circumstance, our navigators, during a period when "night effect" is present, select for navigation

Military Pilot First Class, commander of a fighter element, Capt. N. F. Kuznetsov. For outstanding success in combat training, he has been awarded the Orders of the Red Banner and the Red Star.

Photo by Yu. N. Skuratov

the stations that are located close to the aircraft's flight path and make maximum use of the PSBN sight, the operation of which is not affected by this phenomenon. A flight route is selected in advance over check points that are characteristic in relation to radar.

Summing up some of the results, it is necessary to point out that every navigator in night flying must have firm habits in the operation of the instruments, must navigate actively, and must be ready at any moment to make a decision if the situation should become complicated.

How then should air navigation at night be conducted?

We shall relate only the experience accumulated by our navigators flying on front-line bombers not equipped with astronavigational facilities, and we shall touch upon the conclusions that flow from flying at night in the cloud cover or above the cloud deck when light checkpoints are not visible, i. e., under the most difficult conditions.

In all cases when the ground is not visible, the homing radio station of the take-off airfield is taken as the IPM [point of departure]. If the wind is not known, the course followed from the IPM is equal to the ZMPU [given magnetic course angle] which is definitized after 5-7 minutes of flying from the homing radio station after the FMPU [actual magnetic course angle], the US [drift angle], and the BU [lateral deviation] are determined and corrections in the course are made with the aid of the ARK-5.

To get on the prescribed course, a maneuver is resorted to — flying in a pattern and climbing to the prescribed altitude. In this, use is made of the elements of the pattern and the KUR [radio station angle of approach] which is precomputed for turning the aircraft to the homing radio station. From that point the pilot proceeds exactly as in approaching for a landing by a landing system, i. e., he "gathers" the needles of the DGMK [long-range gyromagnetic compass] and the ARK so that at the moment the homing radio station is passed the DGMK shows the prescribed heading and the ARK shows KUR=0°.

If in flying to the homing radio station the needles are not "gathered", then the pilot follows the beam, holding only the ARK-5 needle at zero (a difference of 10-15° between the actual and the prescribed MK [magnetic course] can be corrected at the moment the "funnel" over the radio station is passed).

The entire maneuver prior to getting on the prescribed course is done independently of visual reference to the check points; but with an increase in altitude the radius of the "funnel" over the radio station becomes increasingly greater and, consequently, so does the time required for turning onto the prescribed course at the moment the radio station is passed.

Checking the flight path as regards distance and the determination of the ground speed are effected on the basis of the distance traveled and the time the fan marker of the adjacent radio station is passed.

For accuracy in determining the US, W [ground speed], and the wind, the aircraft is flown from the homing radio station (IPM) at the prescribed altitude, without changing it for a distance of 70-80 kilometers.

If the aircraft is equipped with a radar sight and if there are check points with radar contrast on the flight path or at a short distance from it, then it is preferable to determine the navigational elements and to check the course by means of the radar sight.

The course is corrected only after the navigator has assured himself by all means available that the deviation has been accurately determined.

The moment of arrival at the control check point or at the PPM [route turning point] is determined by computing the time with mandatory check by means of the PSBN, the system, or on the basis of the precomputed magnetic bearing of the aircraft (MPS), or else by requesting a bearing from a ground radio direction finder.

To simplify the work in the air, the precomputed magnetic bearings of the aircraft taken on the adjacent radio stations should be marked out on the flight chart in advance, depending on their location and on how often a check was made.

When passing over the homing radio station at the IPM, the navigator sets his stopwatch and notes the course of departure from the homing radio station. After 5-7 minutes of flying with the MK equal to the ZMPU or taken with some lead for the drift angle, he begins determining the navigational elements by means of the ARK-5.

The procedure for determining the navigational elements is usually as follows: it is first necessary to set the SUSh [course selector pointer] on the mean MK and to read the MPS [magnetic bearing of the aircraft] = FMPU opposite the blunt end of the needle. The angle of drift is computed by the formula: US = FMPU - MK_{mean}. Cross-checking the FMPU with the ZMPU, the navigator can find the lateral deviation: BU = FMPU - ZMPU.

By the distance remaining and the BU, the correction is computed for the remaining flying time α to the KO [control checkpoint] (or PPM):

$$\alpha = \frac{t_{elap}}{t_{rem}} BU.$$

The course correction (PK) is equal to the sum of BU and α.

The corrected MK is calculated by the formula:

$$MK_{corr} = MK_{followed} - PK \text{ (when the BU is to the right);}$$

$$MK_{corr} = MK_{followed} + PK \text{ (when the BU is to the left).}$$

With such a sequence of operation it is possible during the flight away from the radio station not only to determine the different navigational elements but also to reliably check the course with respect to heading and to correct it in good time.

Furthermore, the precomputed MPS help the crew to maneuver in speed in order to approach the target (KO) at the prescribed time, while the bearings, plotted through the point of the beginning of the turn (at the PPM), make it possible to enter the next leg of the flight on the prescribed course (on condition that speed and bank are maintained).

We shall not discuss here the sequence for determining the wind by means of the ARK-5 when flying at night; there are several such methods and they are quite well known to navigator personnel. We shall note only that we teach our navigators to determine the wind by two US [angles of drift] over the homing radio station or by means of the NI-50b [navigational indicator] and the ARK-5 by a double pass over the homing radio station on a closed curve. Unfortunately, the first method has the shortcoming that it is suitable only for single aircraft and takes much time (up to 20-25 minutes).

Usually when flying at night the NBP [start of bomb run] is entered and the bombs are dropped with the aid of a radar bombsight or by the navigation and bombing system.

We have already noted that the PSBN is used very extensively in night flying, particularly when the ground is not visible. And even if the ground is visible, it is virtually impossible to cross-check the radar image with the terrain below because only the lights are seen while the check points themselves remain obscured. Nevertheless, navigation by the image of the terrain on the scope of the IKO [plan position indicator] of the PSBN has very much in common with navigation by optical (visual) reference to the ground.

For successful use of the PSBN for navigational purposes, the navigator must determine the navigational elements, carry on dead reckoning, and determine in advance what check points he should see on the scope at that particular time and in what portion of the scope they should appear. Only in this way will he "recognize" an image on the scope which will confirm the accuracy of his computations.

There is a complete analogy here with navigation under conditions when the ground is visible. On a clear day and at night when the check points are visible, the navigator may become disoriented if he has not determined the navigational elements and has not carried on dead reckoning. Exactly the same thing can happen when using the PSBN.

In visual orientation, the navigator, in determining the navigational elements and carrying on dead reckoning, does not look continuously at the ground but checks his calculations by periodically comparing the map with the terrain. In working with the PSBN there is also no need to watch the scope continuously.

The following navigational problems can be solved by means of the PSBN: course orientation and check by computing the aircraft's position; determination of the basic navigational elements (altitude, course angle, drift angle, ground speed, wind).

In solving any navigational problem by means of the PSBN, use is made of the scope on which can be seen and, if necessary, identified, certain check points called radar check points. However, the solution of any problem on the PSBN scope is inseparably associated with use of the magnetic compass. In order to determine the MS [position of the aircraft], the velocity and direction of the wind, and the track angle, the angular magnitudes obtained on the IKO scope in stabilizing the course are plotted from the magnetic or true meridian on the chart with consideration of the aircraft's magnetic course.

A positive feature is that by using the PSBN, navigation can be performed independently, i.e., without any ground equipment whatsoever. If there are ground pulse-type radio beacons operating in a centimeter range in conjunction with the PSBN, the latter becomes an electronic system that is one of the group of mixed systems (i.e., azimuth bearing and distance measuring systems) which permit establishing the heading and the distance to radar check points or the radio beacons (active reflectors).

In order to successfully perform navigation along a flight route using visual orientation, the navigator must study the route and the system of check points prior to the flight. As a result of such study, he will be able to "see" the real objects on the earth's surface behind the conventional symbols on the flight chart.

The same thing can also be said of preparation for flight utilizing a panoramic radar station. Before going out on the flight the navigator studies the route and the system of check points, and evaluates the objects shown on the map from the viewpoint of their use as radar check points. It must not be forgotten, for example, that highways and railroads may serve as excellent linear check points in visual orientation, whereas the images, not only of these objects but even of much larger area check points, cannot be seen on the IKO scope. This means that they should not be relied on for night flying. The same thing can be said of small rivers, the majority of which cannot be seen on the scope. Of the many check points on the map, the navigator should know how to select the most important and most reliable ones, of which it can be said with the greatest probability that they can be clearly seen on the scope.

Certain limits should be set for the use of the PSBN in drawing up the navigator's flight plan. The possibilities of the sight must not be overestimated as regards the range of check-point visibility and the clarity of check-point reproduction on the scope. For this purpose, the visibility boundaries of this or that check point may be marked out on the map by a circle, the radius of which corresponds to the presumed range of perception of the check point.

In order to confirm the possibility of utilizing the proposed radar check points in flight and of discovering other check points not marked on the map, a radar reconnaissance is made of the flight route. The pictures of the PSBN scope obtained in such a flight, mounted on positive film with some interpretative inscriptions and legends, make it considerably easier for the navigator to recognize a terrain on the scope and are reliable material in training the crew for a flight using the PSBN for navigation.

The heading on the PSBN scope is established on the basis of the determined drift angles, the angle of approach, and the compass bearing. The course angle is determined with the azimuth stabilization switched off. At such time either the automatic pilot is on, or the pilot holds the course precisely for 1-2 minutes. For marking off the course angle, the mean sighting line is superimposed on the check point image, and the value of the KU [angle of approach] to the check point is read off the scale.

The distance to the check points is determined by the range marks or by means of a calibrated band (for a distance not exceeding 30 km). In using the range marks, it is recommended that the distance on the PSBN scope be measured without any continuous delay in the scanning, and the range scale should be selected so that the check point to which the distance is being determined is approximately in the middle of the scope (half the radius of the TKO [PPI tube face]).

For accurate measurement of distance with the SRP [computer] the "10-60" scale is set in and, after the appropriate knob is rotated, the range marker aligned with the check point, while the ND [slant range] to the check point is read on the slant range scale of the SRP.

In determining the distance to check points, it must be remembered that if it is greater than three times the flight altitude, the ND is assumed to be equal to the horizontal range. If the distance is less than three times the altitude, the slant range must definitely be converted to horizontal range, since the former will be

considerably different from and greater than the latter.

The position of the aircraft can be found by means of the PSBN by several methods: by a check point under the aircraft or in its vicinity; by two bearings of two check points; by two distances to two check points; by the distance and bearing to one check point. The latter method has found widespread application in practice among Air Force units as the simplest and most convenient method, requiring no additional computations.

The drift angle is also computed by several methods. However, the radar check point by which the US is determined should meet the following requirement: that in moving across the scope it does not change its configuration and does not disappear from the field of vision of the sight. To this end, "reliable" check points are selected: a bridge, a characteristic bend in a river, lake, or shoreline. If an inhabited place or some point in a hilly terrain is selected as the check point, the outline of such a check point may change drastically as the aircraft moves, or it may disappear entirely, and it will be difficult to follow it across the scope.

Each of the methods of determining the drift angle by means of the PSBN requires a particular sequence in operating the sight, has its own positive features, and its own shortcomings. All this is known to the navigator personnel. Only some specific conclusions made by our navigators on the basis of numerous night flights are in order. Let us assume that the drift angle is determined by the movement of the radar check point on the scope near the line of flight. If the check point is of small size and produces a bright pip on the scope, the movement of its image on the scope can be followed by the afterglow it leaves behind as it skips across the scope.

If on the scope there are no check points near the line of flight or the course line, but there are such check points to the right or left of the aircraft, then the US is determined by taking two bearings of one check point.

Finally, the US can be found by two measurements of the slant range to a check point situated near the course line. Our navigators frequently use the following variant of this method. If the check point is observed in front at a small KU $\approx$ 5-6°, then the navigator should without any additional turn of the aircraft read the KU_1 at the moment the check point is at ND = 40-30 km. After the check point gets to half the distance, 20-15 km for example, the navigator reads the KU_2 and calculates the US by the formula: $US = 2KU_1 - KU_2$.

And how do things stand with computation of the ground speed?

It is known that to determine W it is necessary to know the time during which the aircraft covers some segment of the path from the check point. The navigator's mode of operation is selected according to the position of the radar check point relative to the line of flight.

The ground speed can be calculated by the time two identified check points pass under the aircraft. This method is simple, but the check points identified on the scope do not always appear under the aircraft.

If the ground speed is measured by the time of passing one check point, identification of the check point is not obligatory. Speed is determined by the time the check point passes through two range marks. To reduce error it is necessary to increase the flight base to 30-40 km, to know the US, to pick a check point along the line of flight, and to compute S by means of the marker of the timing signal and not by the range marks.

Very convenient is the method of determining ground speed when the radar check point is located to the side of the line of flight. This makes it possible to find the W and the US at the same time. The accuracy of this method is high enough, and in addition side radar check points are encountered much more frequently in flight than are check points along the line of flight or along the aircraft's course line.

These are some of the special features of air navigation in night flying and methods of determining navigational elements.

A DIFFICULT EXAMINATION

Guards Maj. A. N. Kiselev

This was a hard, but long-awaited day for Capt. Pavel Petrovich D'yakov, one for which he had been preparing for a long time. More exactly it was a night, a flying night.

He, as squadron commander, was in for a night flight under adverse weather conditions in order to confirm his right to become a military pilot first class. He was being checked out by the piloting technique inspector who had arrived at the unit.

Several months of strenuous work preceded this flight. And although everything indicated that it would go well, still D'yakov was as nervous as he had been some time ago before his most crucial examination. He considered that in the final analysis the forthcoming flight would not only sum up the work of perfecting his personal flying skills, but also resolve a fundamental question on which, it seemed to him, depended his further activity as squadron commander.

Even before his appointment to the unit D'yakov had to perform for some time the functions of political deputy to the squadron commander, and later he was transferred to the post of squadron commander. He coped quite well with his work and received a number of commendations from the command.

But when he reported to the same duty in a new unit the situation became rather unique. Really, what is to be done if in the squadron of which you are appointed commander, your future deputy, the flight commanders, and even the senior pilots have a first class rating while you have only a second class? And even your experience as squadron commander is not very great. Are you morally entitled to assume such a responsibility? Will you be able to cope with it? Would it not be better to perform first the duty of deputy rather than that of commander, to adapt yourself, to test your capabilities?

Not only D'yakov had doubts but, quite naturally, the unit commander too, since he wanted to entrust the squadron to safe hands.

Finally the senior officer approved Capt. D'yakov as squadron commander. That is when D'yakov promised himself that he would do everything to justify this confidence, to catch up with the best trained pilots of the squadron, and to obtain in the shortest time the rank of military pilot first class.

What had happened since then?

From the very first days in the new outfit Capt. D'yakov had much and serious work to do. Besides his desire to raise himself to the level of pilot first class he had to get fully into shape in the shortest possible time after an interruption in flying. Indeed, the flight training of an Air Force unit commander is closely tied up with his activity as commander and in the end determines the success of all the work.

What was the actual situation in the squadron at first? The scheduled dates for checking out the piloting technique of the flying personnel were approaching. Usually this is done by the commander himself. But D'yakov was not entitled to check out the pilots since after the interruption he had not yet been allowed to do this type of flying. This meant that the checking of the piloting technique had to be assigned to the deputy. Or there is the matter of analyzing the scheduled exercise. The commander himself did not carry out this task; he only watched the operations of his subordinates from the starting line. Again the flight would be analyzed chiefly by his deputy, Capt. N. I. Mityashin, and by the best-trained flight commanders — most often by S. Z. Bukchin.

Officers Mityashin and Bukchin were experienced pilots. They understood well the difficulties with which their commander was confronted and they tried to encourage him, to help him in any way they could without at the same time stressing their superiority in the individual elements of flight training. It was clear that such a situation could not continue long. D'yakov realized this well; besides, he was not used to working in such a way.

That is why he himself wished to fly as soon as possible, to master the flying program, to stand on the same level as the best pilots of the outfit. The unit commander fully understood his desire but nevertheless he could not allow the quality of flight training to suffer in the slightest degree as the result of haste. His remarks following each sortie for a check of piloting technique seemed to stress that Capt. D'yakov ought not to hurry.

The unit commander was exacting. The very first check-out flight into the zone by day under normal weather conditions showed that even the least omission in the air did not pass unnoticed. The pilot carried out the assignment. But the commander merely mentioned in passing the positive aspects of the flight, remarking that in the zone D'yakov piloted calmly and with confidence. He put the main stress on the defects, drawing D'yakov's attention to the fact that the vertical figures were not being made clearly enough ("cleanly" as the commander put it) and that, in subsequent solo flights, he would have to polish up his piloting technique.

The officer went up again and again carrying out the scheduled exercises and working on the elimination of the defects which had been pointed out to him.

Spring came and went before the following entry appeared in Capt. D'yakov's flight log after a scheduled check-out flight into the zone for advanced flying practice: "Piloting energetic, competent, confident. Has mastered methods of teaching. I permit instruction flights by day under normal weather conditions."

It was only later that the officer understood and really appreciated the genuine care which the unit commander was taking of him. Knowing that there was someone in the squadron to rely on, the unit commander was in no hurry. He wanted D'yakov to act with dead certainty after he got into the instructor's seat in the aircraft, to act as a real mentor and skillful teacher of his subordinates.

Affairs in the outfit were taking their normal course. P. P. D'yakov was firmly getting into the routine of his multiple duties. A commander's exactingness, the experience of a political worker, the ability to approach people, to direct their energy toward solving the most important tasks — all this gave him real authority. But the main thing was that he was persistently mastering the flight program.

D'yakov stubbornly went on perfecting himself in group flying teamwork, in carrying on air combat, in firing at air and ground targets, in flying at night and under adverse weather conditions. Soon he was allowed to fly as an instructor by day under minimum weather conditions for that airfield and later on also by night.

A large group of pilots arriving from military school reported to the unit. The command, deciding to whom it might entrust their training and education as well as their integration into the unit, chose the outfit commanded by Capt. D'yakov. In this choice by far not the least of the considerations were the personal qualities of the officer and the fact that this squadron was firmly established as one of the topnotch outfits. The ranks of its best men were constantly being augmented by new Outstanding Men in combat and political training.

Despite the fact that some of the best-trained pilots had been called to other units, the remaining officers were fully prepared for coping with the new task. Capt. Mityashin, the commander's deputy, rendered true assistance to his squadron commander. In the two flights commanded by officers S. Z. Bukchin and N. V. Kuznetsov all the pilots, technicians and mechanics were Outstanding Men.

Among the best officers of the outfit who by rights should be mentioned are N. P. Limonov, N. L. Ustavich, A. S. Shurygin, G. I. Kurotopov, G. I. Plotnikov, V. A. Smol'yakov, A. A. Shavrin and many others on whom the commander could fully rely. Most of the junior Air Force specialists have become Outstanding Men in combat and political training, as, for example, senior aircraft mechanics N. A. Aref'yev and L. A. Reznik, and private first class A. I. Mamadaliyev and M. M. Landa.

Capt. P. P. D'yakov before flight.

Owing to the selfless efforts of the flying personnel, the flight training plans are always carried out successfully. Intensive training in the air goes off without any flying accidents. The technical personnel ensures reliable and unfailing operation of equipment. Military discipline is at a high level. Officers, sergeants, and privates work as a team at raising the level of political knowledge. The experienced hand of the commander is felt everywhere; he acts as a skillful organizer and thoughtful tutor of his subordinates.

The confidence of the command, which entrusted to them the integration into the unit of young pilots, is a worthy evaluation of the work of the squadron personnel and its commander. But at the same time it placed a special responsibility upon the entire team.

Having consulted his deputy and flight commanders and having evaluated the actual possibilities, D'yakov decided to carry out the task as soon as possible. Even during the first months of the young men's presence in the squadron much was done in this line.

Ground training went off exceptionally well. The young officers learned all that was included in the program: the flying area, instructions concerning carrying out the flights and navigational duties. They concluded their technical training. At the appointed time all passed their examinations and soon they started flying. It is enough to say that the young pilots logged 6 - 7 times more hours in a few months, than in the course of the entire previous year.

A typical feature of Capt. D'yakov's work is his faith in youth. But his faith is combined with the strictest exactingness and unremitting control.

From the very first days of service the young officers felt that in the outfit everything was subjected to a definitely fixed order and no deviation from it would go unnoticed. Once flying was scheduled for a Monday. In the squadron one rule is punctually observed: on the eve of flying the flight personnel must always get a normal rest. The commander strictly enforces this rule. So it was this time also.

At 1100 hours the commander dropped in on the young pilots in the barracks. Two of them — Lieutenants K. I. Shust' and B. I. Sirota — were still absent. And although afterwards they asserted that they were only a few minutes late, Capt. D'yakov did not alter his decision: both pilots were not permitted to fly. Thus, from the very first moments of their stay in the squadron young officers get used to following a fixed order in everything.

Another case was also the source of serious conclusions drawn by all the young pilots. Lt. N. I. Ippolitov mastered the flying program quite quickly. Despite the fact that the young pilots in the squadron are assigned approximately the same amount of flying time, he was one of the first to take up the concluding flying exercises in individual training.

This slight advantage over the rest of his comrades turned Ippolitov's head a little. The legitimate wish to go on being in the forefront almost brought directly opposite results. The lieutenant took off to the zone to carry out an ordinary flight maneuver at an altitude of 9000 m. He tried to carry out the mission as well as possible and got carried away.

The flight control officer warned him over the radio that, the time being up, it was time to return to the airfield. The pilot replied that he had understood the command. But looking around he suddenly could not determine which way to go.

If he had admitted this immediately and reported it to the command post, all would have been corrected very easily. Yet pride prevailed, together with a false feeling of shame before his comrades for his oversight. Ippolitov decided to conceal that he was not sure where the airfield was located and did not know what course to take. For this reason the situation immediately became complicated.

When, five minutes later, the flight controller inquired about the position of the plane, Ippolitov replied that he was approaching the second turn. Actually he was flying on a course away from the airfield. He had lost his bearings.

The unit commander, who was in the air at this time, helped the pilot to alter his course, to fly towards his airfield and to land. But there was hardly any fuel left in the tanks of Ippolitov's plane. Flying had to be stopped immediately and this case had to be analyzed with the flying personnel. A punishment was inflicted on the culprit.

As an exacting and tactful commander, Capt. D'yakov was convinced that Ippolitov himself as well as all the officers, realized to what end insincerity and lack of truthfulness may lead, and that from this they had learned a lesson. Nevertheless, he ordered that once more a thorough check be made of how well Lt. Ippolitov knew the Navigation Regulations, the flying area and the instructions on regaining one's bearings. After this he personally flew with the pilot on a check-out flight for practical regaining of bearings. The pilot handled the mission well and the commander again allowed him to undertake independent flights, thus showing him that he trusted the pilot and thought that he would not make a similar mistake again.

This is how the weekdays of intense creative work pass in officer D'yakov's outfit. And after many difficulties had been overcome, after merited recognition and true authority had come and after he virtually rose to the level of military pilot first class in his personal training, Capt. D'yakov no less than before, and perhaps more, wished to have the formal right to bear this honorable title. That is why he was so nervous on that flying night with which this narrative started.

However, the test which seemed so difficult to the pilot, went off without any complications. D'yakov's training did not arouse any doubts and the piloting technique inspector who checked his flying skill was quite satisfied with the flight. He did not make any remarks and gave the evaluation: "excellent".

Only just a few days passed and the next night flight became a most serious test of Capt. D'yakov's maturity and skill.

This time flights were assigned according to the group commander's plan. As is usual under such conditions, he personally led the preflight briefing exercises. The peculiarity of this briefing was that in the course of it the officers' preparedness to carry out the forthcoming mission was not checked in all its details, but it also served as a model assignment, as an example, which had to be followed by each of the commanders participating in the flights. That is why the entire assignment was discussed in such detail. The headquarters had prepared all the diagrams and visual aids necessary for the use of the officers.

The group commander suggested that Capt. D'yakov tell about the object of the flight mission. Next they started discussing the actions of the pilots in special cases of flight. It might even seem that the commander was asking too much about how one ought to act, should the engine stop in the air or should a fire break out, or how to substitute the readings of some instruments for those of others. After all, these were experienced pilots who had gathered for the flying and not novices.

But it might seem so only to a detached onlooker. He who knows flying and he who has to do with aviation equipment must be ready at any moment and in any situation to rapidly find the correct solution in the most unexpected and complex circumstances. That is why the pilots discussed each problem so thoroughly, again and again repeating the rules in the flying regulations and instructions.

Night came. Flying started. At first D'yakov took off on a combat trainer with a check pilot. Then came the solo flight. The plane was in the air. The powerful engine worked rhythmically, lifting the machine rapidly. Suddenly a violent shock shook the plane and broke the usual climbing tempo. A glance at the instrument — altitude 4000 m. The cabin quickly filled with smoke.

"What has happened?" flashed through his mind, but even before the thought, with movements trained to the point of automatism, the pilot was already trying to open the cockpit canopy. At the moment that was the main thing. D'yakov reported on what had happened by radio and took measures.

The fuel valve has already been shut off and the engine stopped. Again a glance at the instruments and the plane was pulled up to level flight. Mere seconds had passed and 2000 m of altitude were already lost. The pilot made a decision:

"I will land on the airfield!"

The flight controller replied by radio that all the measures had been taken to ensure landing. All the pilots present at the flight line realized perfectly well what it means to land a fighter plane with a stalled engine at night. Orders had been given, everything was ready.

D'yakov's plane approached the airfield, but it was coming in on a course opposite the flight line, which meant that the floodlights were useless. It was also clear that a repeat approach in order to correct the landing computation was also impossible. There was still one more means to facilitate landing at D'yakov's disposal — the landing light. At an altitude of 100-150 m he switched it on, let down the flaps and landed.

People approached the plane, but the pilot had already extricated himself from the safetybelt, got out of the cabin, walked around the plane and, convinced that the machine was intact, went to meet them.

He passed the difficult examination with flying colors.

* * *

The chief of staff was reading an order from the Air Force Commander in Chief concerning him who, to the glory of his unit, whose battle standard was decorated with orders for the exploits of its members during the Great Patriotic War, had added one more courageous feat worthy of this glory in the days of peacetime training. This deed was made possible because Capt. D'yakov, a Soviet pilot and commander, combines the moral and combat qualities of a citizen of the USSR with unimpeachable flying skill.

The brief, laconic sentences of the military order told of all this:

"Compliments and a valuable gift are awarded to Capt. D'yakov, P. P., for selflessness and a high degree of flying skill demonstrated in a complex situation, and for saving a combat plane."

The day which had begun so solemnly in the regiment closed with a festive party in the club, where the unit commander read the Decree of the Presidium of the Supreme Council of the USSR on the award of orders and medals and handed the decorations to the soldiers of the regiment. Capt. D'yakov was awarded the Order of the Red Banner for irreproachable service of many years standing.

Finally one more pleasant surprise was reserved by the commander for his subordinates. At the festive meeting he read a telegram and congratulated Capt. D'yakov, two of his flight commanders, A. V. Kokhanov, M. I. Poluektov, and other officers on their promotion to a first class rating.

Now in Capt. D'yakov's squadron, which is truly knitted and firmly welded together, the entire flying personnel bears the honorable rating of military pilot first class, except for those who recently joined it after flying school. A fighting squadron!

Great tasks confront it. The personnel, headed by their commander, fights with renewed strength for their successful solution.

EQUIPMENT AND INSTALLATIONS AND THEIR OPERATION AND MAINTENANCE

CLIMBING IN INTERCEPTION

Docent, Candidate of Technical Sciences,
Engineer Lt. Col. A. M. Tarasenkov

In flying interception, altitude must be gained in such a manner as to remove the line of interception as far as possible from the object defended. For this purpose, a combat or augmented operation of the engine is utilized. In order to cut the time, it is recommended that altitude be gained at a speed along a trajectory that corresponds to the greatest possible rate of climb. This speed is determined as follows. The vertical component of the flight speed V_y should be plotted on a graph as the function of the speed along the trajectory V at a prescribed altitude.

For each altitude it is possible to establish an appropriate speed along the trajectory corresponding to maximum rate of climb; it increases with altitude. However, for convenience in remembering the parameters of the flight it is accepted practice to give a constant true speed along the trajectory. Let us assume that it is 750 km/hr. Because of the sloping course of V_y along V, climbing at a constant speed along the trajectory does not lead to any significant reduction of the rate of climb as compared to the maximum.

In the interception of high-altitude targets it is not always advantageous to gain altitude at the highest rate of climb, i.e., in a minimum of time. In a number of cases, to move the line of interception away from the objective, for example, in a plane of the MiG type, altitude is gained at a speed considerably greater than 750 km/hr. What causes this and how is the climbing speed required in interception to be determined?

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/10/31 : CIA-RDP81-01043R002400050009-7

The flight trajectory in interception generally includes a sloping and a horizontal portion (Fig. 1). After the altitude has been reached at the highest rate of climb, it may be necessary to fly horizontally for a longer or shorter period to meet the target. If several planes take off simultaneously for interception, that one will be closest to the target that gained altitude at the highest speed and had the shortest horizontal portion of the trajectory. This is due to the fact that an increase in speed along the trajectory increases the climbing time relatively little, but the aircraft nevertheless travels a considerably longer path.

Fig. 1. Climb trajectory.

Figure 1 shows the relative positions of two planes that climbed to an altitude of 10,000 m with rpm n = 11,560 — the first at a speed of 700 km/hr, the second at 1000 km/hr. By the time the second plane has gained altitude, the first has succeeded in traveling some distance along the horizontal; nevertheless the second plane was 30 km ahead of the first. The greater the speed along the trajectory, the greater the gain in the path traveled.

With changes in climbing speed, the line of interception will also change. The method of gaining altitude will have the greatest effect on the position of the line in interception by pursuit. In this case, a gain in the path ΔL km will lead to a shift in the line of interception by a value:

$$\Delta L_{line} = \frac{\Delta L}{\frac{V_a}{V_t} - 1} \text{ km},$$

where V_a and V_t are the speed of the aircraft and the target, respectively.

When the ratio $\frac{V_a}{V_t} = 1.1$, a lag behind the target of, for example, 10 km will require an additional pursuit of 100 km.

Figure 2 shows the gain in the line of interception ΔL_{line} of a target flying at an altitude of 10,000 m when the climbing speed is 1000 km/hr instead of 700 km/hr. The dotted line indicates the shift in the line when the speed ratio is $\frac{V_a}{V_t} = 1.2$; the

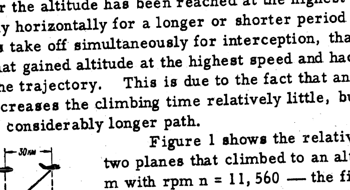


Fig. 2. Shift in the line of interception due to an increase in average flying speed.

solid line when it is $\frac{V_a}{V_t} = 1.1$. The points on the diagram allow us to determine the gain in the line obtained in different interception courses. It follows from the diagram that the nearer the interception course is to pursuit, the more important it is to gain altitude at a high speed. For example, with $\frac{V_a}{V_t} = 1.1$ and with a takeoff to meet the target, the shift in the line will be only 15 km; with an interception course perpendicular to the course of the target it will be about 60 km; and with a takeoff for pursuit it will be 300 km.

Is it necessary in all cases to increase the average climbing speed? It is not. This should be done only when the fighter manages to get to the altitude of the target at a high speed. If the target is spotted late, then with a takeoff to meet the target the fighter may slip by underneath it; the same thing can also happen in takeoff for pursuit.

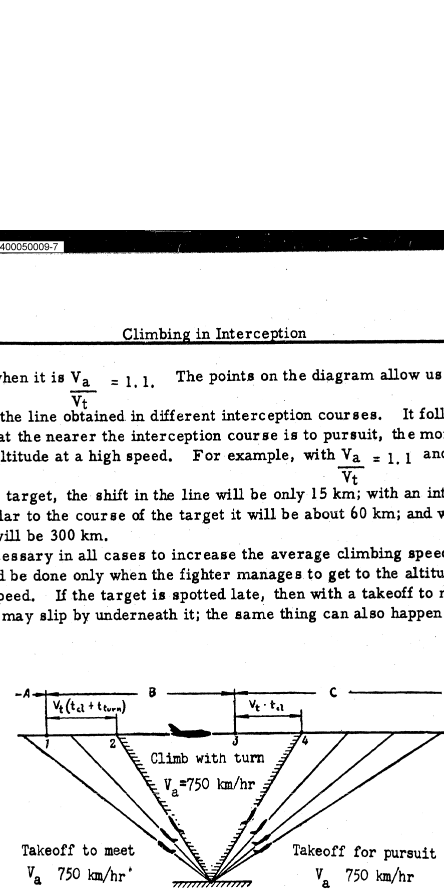


Fig. 3. Zones of the position of the target relative to the fighter's takeoff point.

Relative to the fighter's point of takeoff there are three zones of target position— A, B, and C, as shown in Figure 3. If the target at the moment of the fighter's takeoff is in zone A, i.e., left of point 1, then altitude must be gained at high speed to meet the target. Point 1 shows the position of the target when, in climbing in minimum time, the fighter which is flying to meet it reaches the required altitude at point 2 at the beginning of his turn. For every position of the target at the time of fighter takeoff left of point 1, the speed along the climb trajectory can be selected so that the fighter will reach the given altitude at the point for beginning his turn. The farther the target is from point 1, the greater must be the speed of the fighter, and the farther from the objective will be the interception.

If, at the moment of the fighter's takeoff, the target is in zone B — between points 1 and 3 — then altitude must be gained at the highest possible rate of climb along a curvilinear trajectory (in plane view). At the beginning of the climb, the flight is made to meet the target. At the end of the climb the pilot must guide the aircraft to the attack line, i.e., turn it at an angle of 180°.

Finally, if at the moment the fighter takes off, the target is in zone C — to the right of point 4 – then altitude must be gained at a speed increasing proportionately with the distance to the target. Let us determine the speed of climb, assuming that in flying to the target the fighter has a minimum horizontal section of the trajectory. We will thereby also find the flight regime that will put the line of interception as far as possible from the objective. Let us assume that from the time it is spotted the target moves in a straight line and uniformly. In the process of the ground controller's preliminary calculations on the plotting board, it is necessary to determine the course and speed for interception.

Let us take a case where the target is flying toward the takeoff airfield. We determine the fighter's course independently of its speed. We will then find a speed such that the fighter has a minimum horizontal section of the trajectory, and at the same time, such that the given altitude is reached at the point of beginning his turn or at firing distance. To avoid slipping past the target underneath, it can be recommended that the target's flight altitude be assumed in the calculations as 0.3-0.5 km higher than it is.

Let us suppose that the target is spotted in good time and it is required that the line of its interception be kept at a distance. Then the speed for interception can be found by superimposing two graphs drawn on tracing paper (Fig. 4) on the plotting board in a definite way. Figures 4a and 4b show the paths followed in gaining different altitudes, beginning with 5 km, at different speeds with combat (Fig. 4a) and augmented (Fig. 4b) operation of the engine. Each ray drawn from point T corresponds to a specific flight altitude. The dotted lines depict the segments of the track traveled at any given speed along the trajectory. The solid curves correspond to uniform time intervals from the moment of takeoff. Figure 4c shows the path traveled by the target as a function of the speed and time of flight. Each rectilinear ray corresponds to a definite flight speed. The curves plotted on the graph are shown by equal time markings.

It is desirable to construct the graphs on tracing paper to the scale of the map. Then graph I (Fig. 4a or 4b) is placed on the plotting board so that point T coincides with the ITN [initial vectoring point] (the takeoff airfield). The ray, marked by the altitude equal to the altitude at which the target is flying, is pointed along the course of the target. Graph II (Fig. 4c) is superimposed on the plotting board in such a way that the ray marking the speed equal to the speed of the target is pointed along the target's course. The designation of the target on the map should coincide with the time mark on the graph corresponding to the sum of the turning time and the passive time: $t_t + t_{pass}$, as shown in Figure 5.

It is now easy to find the computed point of beginning the turn and the speed required to attain altitude. For this, we find on the target flight line the point at which the lines of equal time intervals on both graphs converge. In our case, the lines of the 7-minute intervals converged. This will be the projection of the point of beginning the turn on the target path line. By interpolation between the dotted lines we determine the flight speed corresponding to the point found. In the example given in Figure 5 it is 910 km/hr. It may happen that the lines of equal time intervals do not converge at all; then two lines with the closest time intervals should be found and the desired point should be taken in the center of the distance between them.

If the target is spotted far from the airfield or has a low flying speed, then even

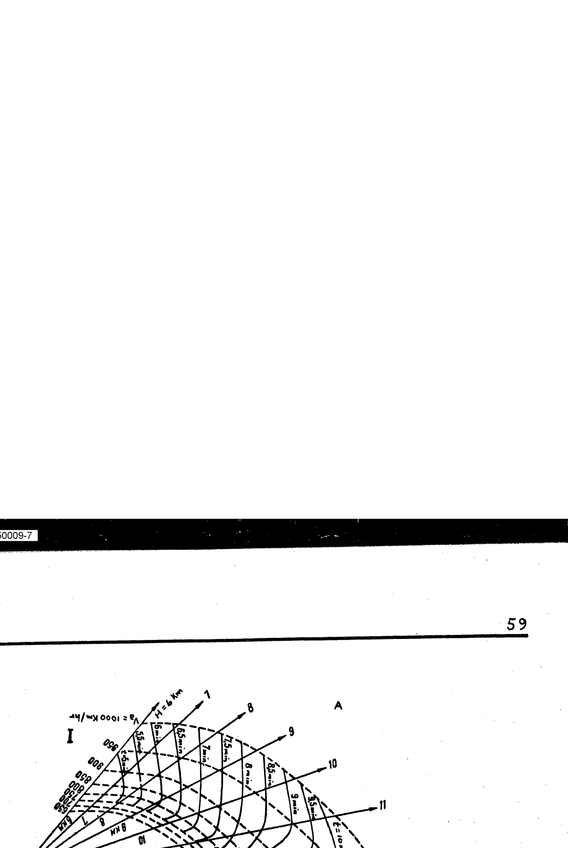


Fig. 4. Auxiliary charts for making preliminary ground-control computations.

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/10/31 : CIA-RDP81-01043R002400050009-7

Fig. 5. Diagram for determining speed in climbing.

the lines of the greatest time intervals may not converge (the graphs will "diverge"). This will mean that it is necessary to gain altitude at the highest speed, 1000 km/hr for example, and then fly horizontally to meet the target. If the target is spotted late, it may be found that even the lines with the smallest time intervals will not converge (graphs I and II "overlap" each other). This means that the target is in zone B (Fig. 3) and altitude must be gained at the highest rate of climb with simultaneous turn.

However, sharp turns are not advantageous in this case, since they increase greatly the drag of the aircraft, thus slowing the climb. The turn should be made as gently as possible; then the required altitude will be attained more quickly. Sharp turns are, however, disadvantageous. We shall prove this by an example. Suppose the aircraft is climbing to an altitude of ΔH = 2000 m by two methods: (a) a climb to ΔH = 1000 m, a sharp turn of 180°, and a further climb to ΔH = 2000 m; (b) a climb to ΔH = 2000 m with a simultaneous sloping turn of 180°. The time of the maneuver will be 40 seconds less in the second case than in the first.

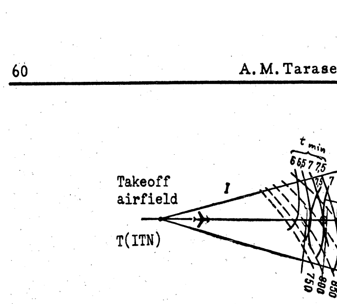


Fig. 6. Diagram for determining course and speed in interception.

If the target is spotted late and interception is possible only by pursuit — which is entirely possible under combat conditions — the procedure for using the graphs is just the same. But graph I must be turned so that the ray corresponding to the target flight altitude is directed, not to meet the target, but to catch up with it. Obviously, no turn will then be made and when graph II is superimposed on the plotting board only the passive time should be considered in the computation.

We have discussed the case of a target flying toward the fighter's takeoff airfield (ITN) or close to it. In this case it can be assumed that the fighter will first fly directly to meet or to pursue the target. If the presumed path of the target deviates considerably from the takeoff airfield, then the problem is more complicated and it is necessary to determine the required course of the fighter in gaining altitude as well as its speed. The speed and the course of the fighter will then be interrelated and can be determined only jointly. We shall show the method of solving this more general and more complex problem.

It is expedient that the fighter's course and speed be selected so that the horizontal section of the trajectory is at a minimum. It may be required, for example, that the fighter reach the given altitude at the point of beginning his turn, i. e., eliminate any straight horizontal section. We determine the speed and course for interception by the following method.

We lay out on the map the presumed flight heading of the target. From point B' where the target is spotted, we lay off a segment B'B equal to the path of the target (Fig. 6): B'B = $V_t(t_{pass} + t_t)$. Relative to point B we draw the trajectory of the turn required to get to the target with a given angle-off and draw a tangent to it from the initial point of vectoring T (the takeoff airfield). Line TK will show the relative trajectory of the fighter's closing in on the target from the moment of takeoff to the point of beginning the turn K. With sufficient accuracy for practical purposes, line TB can be drawn instead of TK and considered as the relative trajectory of closure. Thus, we arbitrarily make the point of the beginning of the turn coincide with the position of the target.

We find the true course for interception and the required speed of the fighter by solving the interception triangle. From point T parallel to the line of the target path we lay off on a certain scale the vector of target speed V_t. From the end of this vector we draw a line parallel to TB, i. e., one showing the direction of the relative speed of closure.

We take a series of fighter speeds V_{a1}, V_{a2}, and V_{a3} and lay them off from point T on the scale adopted in such a way that the ends touch the line of relative speeds of closure as shown in Figure 6.

We obtain interception triangles corresponding to the fighter speeds selected. A specific course will correspond to each speed V_a. Now it is necessary to find the speed and course that will satisfy the condition imposed — to reach the target altitude at the point of beginning the turn.

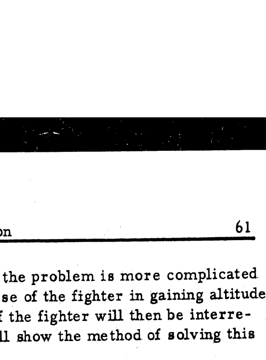


Fig. 7. Use of a parallelogram for determining course and speed for interception.

On the extensions of fighter speed vectors V_{a1}, V_{a2}, V_{a3} we lay off in scale the distances traveled by the fighter in climbing to the given altitude at different speeds. These distances can be obtained directly from the graphs in Figures 4a or 4b. The portions TE_1, TE_2, and TE_3 show the path traveled by the fighter in climbing to the given altitude at speeds V_{a1}, V_{a2}, and V_{a3}. Connecting these points, we obtain line $E_1E_2E_3$, which

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/10/31 : CIA-RDP81-01043R002400050009-7

shows the position of the fighter in climbing to the target altitude at different speeds and on different courses. The point E where this line intersects the line of target flight shows the actual course for interception — heading TE. At the point where TE intersects the line of heading relative to the speed of closure we find the end of the vector of the speed required in the climb.

This method can be simplified considerably by using the simple device shown in Figure 7. In form it is a hinged parallelogram ABCD, whose apex A can be fixed at a given position on the vectoring plotting board. Side AD is extended; links AB and DC serve as guides for moving the rod mm, which always holds a position parallel to line AD. A scale of target speeds should be marked off on side DC or AB so that rod mm moves away from side AD for a distance corresponding to the target speed in the scale we have arbitrarily adopted. Fixed at the apex A is a hinged scale nn marked off in fighter speeds according to the scale adopted. Such a device makes it possible to determine the relationship between the fighter speed and the true course for interception, i. e., to solve the interception triangle.

This device can be used as follows. The parallelogram is laid on the vectoring plot so that apex A coincides with point T (ITN). Side AD is pointed along line TB′ (or TK if a turn trajectory has been constructed); side AB is pointed along the target flight speed; and rod mm is set by means of the scale in a position corresponding to the target speed. Then we assign to scale nn a number of positions, each of which is related to a certain fighter speed. We read the speed on the scale of fighter speeds at the intersection of rods mm and nn. Having the target's flight altitude, we find the distance TE and mark it off in the appropriate direction. Thus we obtain a number of points E_1, E_2, E_3..., and at the intersection of the line connecting them with the line of target flight we find the required point E. Segment TE shows the true course for interception, while scale nn set on this course makes it possible to find the speed of the fighter in gaining altitude. It is convenient to make all parts of the parallelogram out of some transparent material — celluloid, for example.

The temperature of the ambient air affects the rate of climb of jet aircraft. If, for example, the temperature is increased by 10° over the standard surface temperature of 15° C, the maximum vertical speed will be reduced by approximately 10%. A proportionate reduction in temperature increases the rate of climb.

A substantial deviation from the standard temperature must be taken into account in the recommended preliminary ground-controller's calculations for interception. If it deviates uniformly from the standard at all altitudes, then in interception at altitudes around 10,000 m the following correction must be made in the calculations in the target flight altitude as determined by radar. For every 10°rise in temperature over the standard, the calculated target flight altitude must be increased by 1000 m, otherwise the fighter will not have attained the required altitude when he closes in on the target. For every 10° drop in the temperature of the ambient air below the standard, the calculated target flight altitude must be reduced by 1000 m. Otherwise, the fighter will have to fly horizontally along the closure trajectory for quite some time, and this is disadvantageous.

The above operations in determining the speed and course of the fighter in interception must be performed in the time interval between the moment the data on the target (position, altitude, course, speed) are received and the time the fighter takes off, i. e., in the passive time. To do this in such a short time is quite difficult.

Therefore, computations for the most probable speeds and altitudes of target flight should be prepared in advance and prepared graphs such as the one shown in Figure 8 should be used directly in the vectoring.

The spotting line is shown by an arc of a given radius. The graph should be located on the vectoring plot so that the pointer indicating the direction of target flight coincides with its actual course. Then for several points on the spotting line marked off by the methods outlined above (see Figs. 5 and 6) we find point E — the arrival at the target flight altitude and the beginning of the turn — and also the climbing speed. The direction of TE will show the true course for interception, while the vector V_a will show the speed of the fighter to scale. The graph depicted in Figure 8 is used as follows. It is placed on the vectoring plot in such a way that point T coincides with the ITN and the pointer for the target flight heading coincides with the target course. The position of the target is located on the spotting line and a line is drawn for its anticipated course to the intersection with the line of arrival at the target flight altitude. Here the point E for the beginning of the turn is found. The direction TE will show the course the fighter must take for interception, and the required speed in gaining altitude is determined on the polar diagram of speeds.

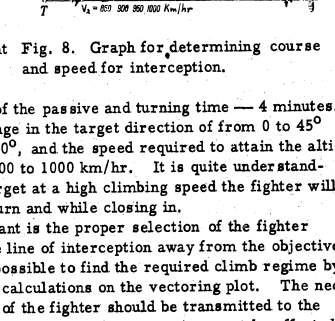


Fig. 8. Graph for determining course and speed for interception.

In constructing Figure 8, the following were used as initial data: target flight altitude — 8 km; true target speed — 600 km/hr; range at which target is detected by ground radar — 170 km; sum of the passive and turning time — 4 minutes. As can be seen from the drawing, a change in the target direction of from 0 to 45° changes the required fighter course by 90°, and the speed required to attain the altitude will change correspondingly from 800 to 1000 km/hr. It is quite understandable that for attacking a slow-moving target at a high climbing speed the fighter will have to be braked energetically on the turn and while closing in.

Thus, it becomes evident how important is the proper selection of the fighter flight regime in climbing for moving the line of interception away from the objective. Use of the methods discussed makes it possible to find the required climb regime by means of preliminary ground controller calculations on the vectoring plot. The necessary command for the course and speed of the fighter should be transmitted to the pilot before takeoff or immediately thereafter. Further vectoring must be effected with the aid of the IKO [PPI].

We have not attempted in this article to give instructions in interception but have merely tried to show how important it is to choose correctly the climbing regime in interception. These recommendations can be used for solving the problem of intercepting aerial targets.

NEW AIR LINERS

On the 40th anniversary of Great October, the Soviet people will receive one more notable gift — the new "Rossiya" aircraft designed by A. N. Tupolev. This is an aerial giant that can carry 170-180 passengers. With a speed of 900 km/hr, it will traverse enormous expanses without landing.

The Civil Air Fleet will in the near future obtain modern new passenger planes with turbojet and turboprop engines.

Under the direction of Lenin Prize Laureate A. N. Tupolev there has been developed the TU-110 plane with four powerful turbojet engines designed by A. M. Lyul'ka (see picture above). The power of all its gas turbines is considerably greater than the power of each individual hydroturbine of the Kuybyshev GES [hydroelectric station]. This new machine is an all-metal monoplane with a sweptback wing. It can fly in the stratosphere at a cruising speed of 800 km/hr. Its range attains 3450 km.

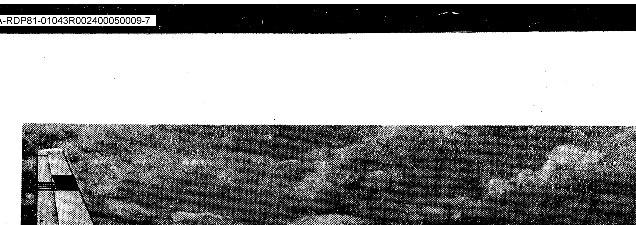
The passenger plane "Moskva" designed by S. V. Il'yushin is equipped with four NK-4 turboprop engines of 4000 hp each. They were developed by a design team under the leadership of N. D. Kuznetsov. This machine is an all-metal, cantilever, low-wing monoplane with a rectangular wing. The cruising speed of this plane is 600-650 km/hr, and its range is so great that it can cover without landing the distance from Moscow to Delhi — the capital of India. The basic version of this machine is designed to carry 75-100 passengers.

Safe flying at any time of year, day or night under all kinds of weather and climatic conditions is ensured on this plane. Attesting to its high flying qualities is the fact that, with four engines, it can continue flying when one or even two of them fail. Its excellent takeoff and landing characteristics and short takeoff and landing run make it an all-weather and all-airfield plane. The outstanding qualities of this machine and the low cost of a ticket (no higher than the cost of a railroad ticket in a hard-seat coach) permit a wide circle of people to use this plane. [See picture below]

The powerful turboprop aircraft "Ukraina" is designed for 84 passengers. It was developed by a team of designers under the leadership of O. K. Antonov. The "Ukraina" covers the distance from Moscow to Kiyev in 1 hour, 15 minutes. Like the "Moskva", this plane is stable and easy to control; a relatively short VPP [runway] (400-600 m) is required for takeoff and landing.

It has a large load capacity and a cruising speed of 600 km/hr.

Installed on the air liners "Moskva" and "Ukraina" are turboprop engines, which are economical for passenger planes flying at cruising speeds of 600-700 km/hr. [See picture below].



Thus, one after another there will be put into operation on the main air lines high-speed, multiplace passenger planes. This continuous progress in Soviet aviation engineering attests to the fact that the tasks posed by the Twentieth Congress of the Communist Party — to increase in the current five-year plan the amount of freight carried by air transport by 2 times and the number of passengers by 3.8 times — will be resolved successfully.

Over 50 pilots participated in the development of the pilot's cabin for the "Moskva" plane. Their suggestions were carefully examined and all the best was taken into consideration.

In the photo: Test Pilot V. K. Kokkinaki (left) and Pilot E. I. Kuznetsov in the cabin of the "Moskva" plane.

PREPARING THE RADAR SIGHT FOR BOMBING

Engineer Maj. A. N. Davydov

At one time in our unit, cases of the radar bomb sight's getting out of adjustment and out of calibration in the air became more frequent, not infrequently leading to impairment of the accuracy of bombing.

Thus, because of systematic malfunctioning of the 5:1 and 6:1 frequency dividers there developed "sectoring" of the sweep, doubling of the range and image blips, breaks in sweep limiting as a consequence of maladjustment of its amplitude and duration.

What was the trouble? How to explain the situation that developed?

We made a study of the electrical circuits of the pulse frequency dividers and the sweep limiting and determined that the causes of their systematic malfunctioning were improper preparation of the sight by the technical personnel and inadequate checking of it by the navigator before flight.

Not infrequently it happened that the technical personnel, assuming that the navigators would adjust the sight completely before flight anyway, performed this work imperfectly.

In order to prevent such occurrences, we prepare aircraft equipment for flight more carefully. All the necessary adjustments and calibrations that determine stable operation of the sight in flight are made by specialists in the process of preliminary preparation of the sight, while the navigator checks the efficiency of the system and its circuits on the eve of a sortie.

As a result, we managed to reduce the time required for checking the sights before flight by more than half. It has become much easier to use the sights in flight, efficiency of operation has been increased, and this in turn has instilled confidence in the navigator personnel in the reliability of the sight and has given more time for solving navigational and bombing problems.

In practice we have encountered infractions of the sequence in the operation of the sight in flight and improper setting of the controls.

Improper setting of the controls created the impression that the sight was out of order. In attempts to correct the apparent "malfunctioning", its operation was impaired even more, which, in the final analysis, led to serious consequences.

Here is still another sore point. We noticed that the knob of the "delay for altitude" potentiometer on the operator's control panel was quite often set in the wrong position. As a result it might be thought that the sweep limiting circuits were malfunctioning. In such cases, the navigator starts turning the screw adjustments of the "amplitude" and "range" potentiometers on the synchronizer, and this creates an unstable sweep ("sectoring").

Improper setting of the "delay for altitude" knob is further dangerous in that it may cause an error of 2 m or more in determining the slant range to the target, since the navigator gains a false impression that the range calibration of the syncho-

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/10/31 : CIA-RDP81-01043R002400050009-7

apparatus has changed. In trying to calibrate the sight he makes an error in range.

Furthermore, accidental movement of this knob in flight is not impossible because it is located beside the control of the "10-70" potentiometer, which the navigator uses frequently.

In order to prevent such errors, we locked the knob of the "delay for altitude" potentiometer in the extreme left position, and in the process of operating the sight we do not check the calibration of the delay for altitude.

Incorrect setting of the knob of the "zero altitude" potentiometer in the range unit also led to serious annoyances. However, since the delay multivibrator does not operate steadily, we could not lock the knob. A solution was found, however. In testing the sight we changed the procedure for setting the knob. First it was set to make the first 20-km mark coincide with the beginning of the sweep on the 100-km scale (before checking amplitude and duration), and finally to make the main pulse coincide with the beginning of the sweep.

Now the navigator personnel, before checking the accuracy of the range calibration of the synchro-apparatus in flight, correct without fail the setting of the knob of the "zero altitude" potentiometer by the main pulse.

Such measures as locking the knob of the "delay for altitude" potentiometer and changing the method of setting the knob of the "zero altitude" potentiometer have led to the elimination of major deviations in range in bombing.

Still another case comes to mind. Once in checking the "zero altitude", the navigator left the "sweep delay in km" switch (on the operator's control panel) in the "20" position and he got the impression that the range calibration of the synchro-apparatus was out of order; as a result, a substantial range error was made in bombing.

After that, in order to prevent incorrect setting of the "sweep delay in km" switch we eliminated the check of the "zero altitude" control, changing the switch from the "0" position to the "20" position.

The switch on the altitude unit of the optical sight, when it is in the "on" position, disrupts the range calibration of the synchro-apparatus and causes major errors in bombing. To prevent accidental switching on of the altitude unit of the OPB [optical bombsight] we lock the switch in the "off" position.

Incorrect setting of other controls, although less fraught with serious consequences, may also be the cause of disruption of the normal operation of the sight. For example, if the "calibration" switch in the range unit is left in the "6:1" position, the amplitude and duration setting of the sweep is disturbed and the transmitter is switched off.

But when the knobs of the "high" and the "low" level potentiometers on the operator's synchronizer are left in the extreme left position, there is no receiver noise or reflected signals.

Thus, because of incorrect setting of a considerable number of the controls of the sight and its adjustment, it may appear that the sight is malfunctioning. The experience of our best navigators, officers N. I. Zaytsev, V. I. Rukhtinov, and P. A. Vazhnev, has shown that the existing procedure for checking and adjusting the automatic switch in the synchro-apparatus reduces the operating efficiency of the sight at slant ranges of ND [slant range] = 20 km (H = 10 km and $\phi = 60^\circ$) or ND = 28 km

(H = 14 km and $\phi = 60^\circ$).

The fact is that the actual slant range at which the automatic switch functions is always greater than 28 km. We have had cases where a change from a regime of preliminary synchronization to basic synchronization was made on the ground but it did not occur in the air.

That is why our navigators now check and adjust the change from one operating regime to another for H = 14 km at $\phi = 72^\circ$, i. e., for ND = 43 km. And if the apparatus is functioning normally, the slant range is reduced.

But this is not all. One of the efficiency men of the group, officer G. L. Flerov, suggested that an additional switch be installed for manual selection of the operating regime of the sight. This is what happens. In the event the automatic switch fails, the required synchronization regime can be selected manually.

Formerly the navigator had checked the transverse and the azimuth stabilization of the "vector" sweep by the voltage coming from the OPB transmitters. This operation was performed by means of the "drift correction" and "transverse stabilization" potentiometers on the operator's scope. However, such a check, as it turned out, impaired not only the quality of image stabilization in aircraft drifts and banks but also the accuracy of bombing. Life prompted the need for a reexamination of the established procedure. Now we check the azimuth and transverse stabilization of the image during the regular 25-hour inspection, setting the antenna by the azimuth scale on the drive pinion. After the correction is made, the "transverse stabilization" and "drift correction" screw adjustments are sealed. With the radome removed, we check the accuracy of the course line and the tracking of the sweep with the antenna, as well as the correctness of the setting of the slip ring of the azimuth potentiometer. The technical personnel do this work together with the navigators.

Before flight it is necessary only to check the operation of the transverse and azimuth stabilization mechanisms.

A thorough check of the accuracy achieved in obtaining the slant range from the OPB, made by changing the sighting angle from 72° to 35° every 2°, showed that after proper calibration for range (at slant ranges of ND = 10 km and 20 km or ND = 2 km and 28 km) the magnitude and sign of the error in the slant range data output vary from 0 to 300 m, although the instructions specify deviations of no more than $\pm$ 100 m. In addition, the error would change in sign, which sometimes led to computing a false sighting angle since the navigator tried to hold the target in the cross hairs.

To improve the quality of bombing we introduced a tolerance of $\pm$ 50 m for error in the slant range data output. The range is calibrated for ND = 10 km and ND = 30 km (at $\phi = 0^\circ$ and $\phi = 70^\circ$) and a check is made without fail for ND = 20, 16, and 14 km (ϕ is 60°, 50°, and 40°, respectively).

If the error is more than $\pm$ 50 m, we correct the sawtooth voltage in the bombardier's synchronizer for ND = 20 km (H = 10 km and $\phi = 60^\circ$).

If, however, the error is greater than $\pm$ 50 km, the sawtooth voltage in the bombardier's synchronizer is synchronized for ND = 20 km (H = 10 km and $\phi = 60^\circ$).

Successful execution of flight missions for bombing requires that the navigator know the sight well and have sure skill in operating it.

If he has mastered well the functional scheme of the sight, the navigator can, in the event one of the channels fails, switch to the other, change the regime of starting the transmitter if necessary, and so on.

Inability to correct the simplest deficiencies in the air, to change a tube or a fuse, results in a situation where even an insignificant defect in the sight will have a serious effect on the quality of execution of the mission.

In our group, lessons are held systematically for studying the functional scheme of the sight and training is given in correcting simple deficiencies of the sight on trainers and on stands. During the lessons, various defects are deliberately put into the sight so that the navigators may remember their external manifestations and the procedure for eliminating them.

Particular attention is devoted to the ability to analyze the cause of some deficiency, to select the proper type of tube and change it.

At lessons for technical training and in practical work the engineer of the unit, officer V. L. Sobolevskiy, and navigator officer Ye. I. Vodop'yanov teach the engineering-technical and navigator personnel to test and objectively evaluate the qualitative condition of the sight; they organize joint testing of it by both experienced and inexperienced specialists. This makes it possible to prevent the occurrence of a number of deficiencies in the air.

In these ways we have achieved unfailing operation of the sight in the air, which promotes improvement in the quality of bombing.

THE FIGHT AGAINST THE CORROSIVE TENDENCIES OF AVIATION FUEL

Professor, Doctor of Technical Sciences,
Engineer Lt. Col. Ya. B. Chertkov
Candidate of Technical Sciences, Engineer Maj. V. N. Zrelov

The components of the fuel system in a jet engine are manufactured of alloys of nonferrous metals and alloyed steels, which are exposed in operation to the action of fuel, oxygen in the air, and to variations in temperature. It is well known that in the course of operation the components of the fuel system sometimes break down.

In some cases the corrosion processes are not sufficiently deep to impair the normal functioning of the fuel system; however, during the overhauling of the engines it has still been necessary to resort to a high rejection rate of the parts of fuel components.

What then is required of the fuel in this connection?

The fuel must possess minimum corrosive tendencies; it must not produce gummy deposits on the parts of the fuel components; no solid insoluble particles should be formed in it which might clog fuel filters and the interstices between parts which rub against each other. This requirement is especially important in the use of the TS-1 and T-2 fuels.

The corrosive tendencies of the TS-1 and T-2 fuels depend on whether or not they contain the so-called active sulphur compounds and water. To the active sulphur compounds belong mercaptans (sulphur derivatives of hydrocarbons with an SH group) and simple sulphur. These compounds may be present in fuel obtained from sulphurous oils.

Mercaptans and simple sulphur are especially active on copper and its alloys with which they enter into direct chemical interaction. Now it is well known that some of the parts of the engine's fuel system are manufactured of copper and its alloys. For instance, the fuel lines, the filter baffle, and the filter screen are made of brass in the VK-1 engine; the bushings of the inner plain-and-ball bearing ring and the rotor of the fuel pump are manufactured of antimony bronze. The corrosion of these parts appears in the form of characteristic tarnished spots, dark brown films, or in the form of a uniform chemical etching of the entire surface.

Some parts of the fuel components have cadmium coatings. Under the action of mercaptans and water a complete or partial destruction of these coatings takes place.

Temperature has a great influence on the speed of corrosion processes of nonferrous metals and their alloys. With increase in temperature the corrosive tendency of the TS-1 and T-2 fuels increases. For instance, with a change in the temperature of the TS-1 and T-2 fuels by 25° (from 95° to 120°C), the corrosion of bronze increases by 1.5-2 times. Temperature variation has the most detrimental influence on the fuel. Thus, after the engine has been shut off, when the conduction of heat due to the circulation of the fuel drops sharply, local overheating is possible in individual units. Under these conditions the formation of gummy deposits on the metal and of insoluble precipitates in the fuel is especially intensive.

Fig. 1. Corrosion of spherical surfaces of plungers and damage to the beveled plate of the plain-and-ball bearing.

The increase of corrosion of the parts of a fuel system under the influence of active sulphur compounds leads also to an intensive agitation of the fuel in the inner chambers of the fuel pumps. In these circumstances the corrosive deposits formed on the surface of the parts of the fuel system are washed off more rapidly. As a result, layers of the metal which have not yet been attacked are exposed to corrosion and the process continues.

Sulphur compounds act differently in corroding the nonferrous metals and their alloys. Thus, antimony bronze suffers considerable corrosion in fuel under the action of simple sulphur, while cadmium and zinc are more resistant. Simple sulphur interacts chemically with the main component of bronze — i.e., copper — and forms copper sulfide. The copper sulfide film is not durable and can flake off, forming insoluble deposits in the fuel.

With an increase in the quantity of mercaptans, the corrosive tendency of the TS-1 and T-2 fuels increases. Such metals as antimony bronze, cadmium and zinc form complex chemical compounds with mercaptans. These compounds are not easily soluble in the fuel and produce adhesive gummy or gelatinous precipitates. Deposited on the parts of the fuel system, these precipitates interfere with normal performance of the parts.

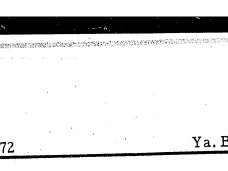


Fig. 2. A non-working surface of the thrust bearing of the fuel pump plunger damaged by corrosion.

For instance, in running a VK-1 engine on TS-1 fuel, which contains a considerable amount of mercaptans, corrosive precipitates in the fuel system partially clogged the passages of several fuel injection nozzles, which led to a stream-like atomization of the fuel. This caused copious carbon deposits of up to 30-40 grams in individual combustion chambers, which was the cause of buckling and cracking of the flame tubes. Upon checking the injection nozzles removed from this engine, it was established that their efficiency had fallen below the standard norm.

While the engine was running, a large deposit of precipitates was also observed on the valve of maximum revolutions; its seating was affected, which led to dripping of the fuel. As a result, the revolutions of the engine dropped by 350-400 rpm in

the takeoff regime. In another case, upon dismantling the fuel installation, corrosion damage was observed on the springs of the servo piston and on the rotor of the fuel pump; deposits were also observed on the walls of the rotor chamber, on the gear of the throttle valve lever, and on the inner surface of the fuel distributor housing. Because of corrosion of the fuel installation and the formation of precipitates, the fuel injection nozzles were partially clogged. Fuel atomization became stream-like, the operating capacity decreased to 392 liters per hr (instead of the rated 410 liters per hr), the non-uniformity of atomization increased. As a result, gummy deposits appeared on the end part of the injection nozzles (0.6 to 1.1 grams instead of the usual 0.2-0.3 grams) and the deposits of carbon increased in the flame tubes (41-47 grams instead of the usual 9-10 grams). This in turn led to the buckling of the first and the intermediate section, as well as to the formation of cracks along the welded seam of the second section of the flame tubes.

Fig. 3. Corrosion of the steel plunger surfaces of the fuel pump under the action of water contained in TS-1 fuel in the form of an individual phase (magnification 6X): a-ShKh-15 steel; b-KhVG steel.

In order to prevent corrosion and avoid deposits on metals and precipitates in the fuel system of the engine, a periodic inspection of the quality of fuel delivered for aircraft fueling is required. Special attention must be given to make sure that the content of mercaptans and the qualitative sampling with a copper plate, which indicates the content of simple sulphur, are within the limits of the established norms. The fuel whose quality does not fulfill the requirements of GOST [All-Union State Standard] and those of technical conditions should not be used for engines.

The alloyed steels used in the construction of the parts of the fuel system are sufficiently inert in relation to sulphur compounds; no corrosion, deposits on the parts, nor formation of precipitates in the fuels have been observed in their presence. Water, contained in solution in the fuels or in the form of an individual phase has a somewhat different effect on these metals.

Corrosion is observed on plungers of the fuel pumps, mainly on the spherical surfaces, in the form of brown spots (Fig. 1); on the non-working surfaces of the thrust bearings it is observed in the form of small points of damage (Fig. 2). Sometimes the cylindrical surfaces of the plungers are also subject to corrosion. For instance, in running a VK-1 engine on TS-1 fuel which contained water in the form of an individual phase, the cylindrical surfaces of the plungers manufactured from ShKh-15 and KhVG steels were corroded. Fig. 3 shows the surface of the ShKh-15 and KhVG steels attacked by corrosion for 6 hours at 95°C under the influence of excess water in the standard TS-1 fuel. The water contained in the fuel may lead to jamming of plungers, damage to the beveled plate of the plain-and-ball bearing (see Fig. 1), and to stoppage of the engine. On other parts, corrosion is observed in the form of separate rust spots, local dark spots, and foci of insignificant depth.

Nonferrous metals and their alloys are not corroded by water in fuels.

The resistance of steel parts of the fuel systems against corrosion in the presence of water is determined above all by the durability and the stability of the protective layer of the metal. If the protective layer is for some reason damaged in operation, even the most inert steels are subject to corrosion in the presence of water to a greater or lesser extent.

The appearance of small points of corrosion damage is a sign of damage to the protective layer. From then on the corrosion may spread.

In overhauling the engines, special attention should be paid to these small areas of corrosion damage on the working surfaces of the parts in the fuel components. All parts with such defects are replaced. In addition to this, the process of corrosion of steels is accompanied by the formation of brown flakes consisting of hydroxide of iron finely dispersed in the fuel. In settling, these flakes may clog filters or other fuel components and may lead to jamming of the plunger pairs of the fuel pumps.

To prevent corrosion of steel parts of the fuel system, a periodic check for the presence of water in drip chambers in aircraft and jet fuel trucks is necessary. The fuel is drained from the drip chambers of the aircraft more often, especially in those cases, when the aircraft have not flown for a considerable period. Positive results are obtained by the drainage of fuel in small quantities for inspection purposes from all drainage points of the aircraft fuel system before every flying day, especially after a sharp change in temperature of the ambient air.

It is recommended that the settled fuel be separated from the water in the GSM [fuels and lubricants] depots before pumping it into jet fuel trucks. The inner surfaces of the drop fuel tanks are inspected in the winter before their installation on the aircraft and the frost collected in them is removed when necessary. All of this permits a considerable reduction of the corrosion damage of the steel parts of the engine's fuel components.

AIRCRAFT TECHNICIAN G. S. KASHKALOV

Engineer Col. Yu. F. Gershevich, Engineer Lt. Col. N. G. Kon'kov

Technician Lt. Kashkalov

Even though G. S. Kashkalov pilots no aircraft through the "Fifth Ocean", together with the pilots in one combat formation he discharges his honorable duty in the Air Force; he very lovingly services aircraft for flight with his labor-loving hands. He is an aircraft technician. This specialty offers many interesting and engrossing aspects; but the man who has chosen this work sometimes comes across great difficulties.

There are no unimportant details in the work of an aircraft technician which can be neglected. The most insignificant error or oversight leads not infrequently to grave consequences.

...It's early morning. No flights are scheduled, and yet Technician Lt. Grigoriy Semenovich Kashkalov and his mechanic, Pfc. Vasiliy Petrovich Budnik are already at work at the hardstand on their aircraft. They remove covers from the plane , prepare the place for work, pick out the required maintenance materials and instruments. "If the working space is well prepared, all the required instruments are within easy reach, the work goes well," says officer Kashkalov.

Budnik is wiping the aircraft. The mechanic painstakingly removes drops of dew and wipes off spots on the fuselage and wings. The crew is concerned with preservation of the lacquer layer. And despite the fact that the aircraft often flies under adverse weather conditions, it looks like new. Kashkalov has set down a firm rule: the surface of the aircraft is wiped before the flight as well as after. Such a — at first glance — seemingly unimportant detail is an indication of the care taken for a combat aircraft which is the realization of the work of many Soviet people.

Since early youth, Grigoriy Semonovich Kashkalov was accustomed to protect government and collective property, to respect the products of human labor. Grigoriy's parents, who worked like hirelings all their lives, breaking their backs for the rich, entered a collective farm. Grisha went to school, later joined a teacher's college. He wanted to become a teacher. But his dreams were not to become reality. He only managed to complete the first year of the pedagogical institute. The grim days of the Great Patriotic War began.

In 1943 Grigoriy Kashkalov was drafted into the Armed Forces. The days of basic instruction in the school of military aviation passed rapidly. And now he is at the front. Radio operator-gunner G. S. Kashkalov takes part in the battle for Budapest in a ground-attack aircraft.

The war is over. Grigoriy Semenovich enrolls in a school for junior aircraft specialists, graduates with excellent grades, begins work as an engine mechanic.

"He loves his profession," says flight technician V. P. Polikarpov of Kashkalov. "He works with a creative spark, confidently, and with initiative. And all the time he studies. He passed exams for a mechanic, and later — by correspondence — for the Military Aviation Technical School. And if correspondence courses in engineering were offered, he probably would also graduate from the Academy."

At present, Comrade Kashkalov services a jet aircraft of the MiG type. For many years his aircraft has been flying without breakdowns. And if the check lists on the preparedness of the aircraft for flight are checked, only one remark can be read: "No criticisms to be made on the performance of aviation equipment."

It is a great, responsible, and honorable task to keep an aircraft in good condition, an aircraft in which pilots fly in any weather. And there have been no cancelled flights blamed on the technical personnel!

How does Technician Lt. Kashkalov achieve this?

Above all, because of a high sense of responsibility for his work, love for aviation equipment, faultless discipline, rigid observance of the instructions and rules laid down by the Aviation Engineering Service, and — what is no less important — because of his knowledge of equipment and the ability to organize his work.

Of course not everything went smoothly at first. Kashkalov himself noticed that there were shortcomings in the performance of the plane's aircraft, radio and radar equipment. But he lacked the experience to analyze the causes and to check the work of the specialists of the respective maintenance teams. Grigoriy Semenovich decides to study the principles of operation of technical equipment. He asks the chiefs of maintenance teams for help, pours over books, familiarized himself with appropriate instructions. Now the aircraft technician does not limit himself to reading the entries on the performance of a particular job in the special documents, but checks the work himself. He always knows the condition of the aircraft, of its equipment and armament, can report on the state of their readiness confidently and in detail. At the close of preflight servicing, the aircraft technician never fails to ascertain that all toggle switches, knobs, and petcocks are in the initial position.

"Now it is impossible to run across pilots," says Grigoriy Semenovich, "who are not able to test the engine by themselves, or to check the operation of all the equipment contained in the aircraft. Unfortunately, however, there still are technicians who are not able to check certain pieces of equipment for proper operation — for instance, the radio station, radio altimeter, radio compass, and others."

It is impossible not to concur with officer Kashkalov's opinion. Indeed, should one tolerate such a situation when a technician, after completing the entire cycle of preliminary and preflight aircraft servicing, is not able to determine whether all the equipment is operating properly? Comrade Kashkalov is quite right when he says that the technician cannot work efficiently and confidently if he does not possess sufficient knowledge to check and accept the work of an aircraft specialist, to hand over the aircraft to the pilot, to pay attention to and understand his comments

on the operation of all the equipment.

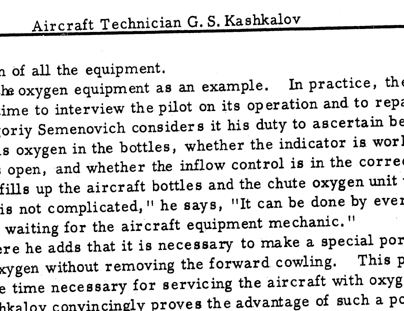
Let us take the oxygen equipment as an example. In practice, the specialist has barely enough time to interview the pilot on its operation and to repair the defects. Therefore Grigoriy Semenovich considers it his duty to ascertain before flight whether there is oxygen in the bottles, whether the indicator is working, whether the air valve is open, and whether the inflow control is in the correct position. When necessary, he fills up the aircraft bottles and the chute oxygen unit with oxygen.

"This work is not complicated," he says, "It can be done by every aircraft technician, without waiting for the aircraft equipment mechanic."

And right here he adds that it is necessary to make a special port to supply the aircraft with oxygen without removing the forward cowling. This permits a 50% reduction in the time necessary for servicing the aircraft with oxygen.

Officer Kashkalov convincingly proves the advantage of such a port, proposed by the chief of the regulation inspection team, Capt. of Technical Services P. V. Khrulev. In a repeat group sortie a situation can arise in which all aircraft are supplied with fuel, oil, air, and ammunition, while the delay will be for oxygen only.

He also told how he succeeded in cutting down the time for aircraft refueling by precisely distributing the work between the technician and the mechanic. Pfc. Budnik first opens the cover of the intake pipe of the drop fuel tank closest to the fuel truck, then proceeds to the other drop tank and concludes with the main tanks. He is followed by the technician who fills the tanks with fuel. After that the mechanic closes the intake pipes of the tanks with covers, screws them down tightly and locks them.



Technician Lt. G. S. Kashkalov reports to Military Pilot First Class N. I. Magerin that his aircraft is ready for flight.

"With such distribution of duties," he says, "we are saving time in aircraft refueling. I fill the tanks, check the tightness, and can switch to other duties."

All the work on the aircraft is done with the permission of the technician. When the specialists check the operation of assemblies and instruments, he takes active part in it.

There exists a well-known rule that the technician is responsible for the completeness of the work done on the aircraft preparatory to a flight. How is this regulation requirement fulfilled in practice by Technician Lt. Kashkalov?

He not only performs the required operations well himself, he also checks continually the work of a great number of specialists employed in servicing of the aircraft for flight. He never surrenders his role of "aircraft boss," the inspector and acceptor of all work done on the aircraft. The technician does not permit the slightest violation of instructions, of unified regulation maintenance and technology, and demands their meticulous observance by all specialists. The mechanic knows that it is only possible to report to him with a plan and list of work in progress, and that only after a check into the condition of his tools will he be allowed to work on the aircraft.

Officer Kashkalov believes that the servicing log and the check lists of the aircraft's flight preparedness facilitate increase in quality of the aircraft's preflight servicing.

Some technicians handle the matter in the following way. Check lists of aircraft flight preparedness are put on the wing — come over and sign them. Thus this important organization and control document is transformed into a "collection of autographs" of mechanics of different specialties and of the team chiefs. The routine is organized entirely differently by Grigoriy Semenovich. Before giving them the check list he will demand that the mechanics carry out all operations required by unified regulation maintenance and will personally make sure that the aircraft is fully serviced for flight.

"Where is your list?" Kashkalov will ask. "Let us go together. I will see how you do these jobs."

With this he gets the specialists used to order. They will know from personal experience that the signature on the check list is not an empty formality.

The aircraft's flight servicing log is kept by the technician. He not only keeps it, but can check at any time what operations have been carried out on his aircraft by specialists of the various services. The fact is that all defects found during flight and during inspection of aircraft equipment, as well as their repair, are written down in the flight servicing log. This is a very important document for the aircraft technician. He is fully responsible for its condition and for keeping it up to date. Officer Kashkalov sees to it that the entries in this log accurately correspond to the work performed.

Let us refer to the following example. After completion of the post-flight inspection, the radio and radar mechanic asked the technician if he might see the aircraft's flight servicing log.

"What for?" Kashkalov asked.

"I must put down that the inspection has been carried out," replied the mechanic.

"And what jobs prescribed by unified regulation maintenance have you done?"

They began to check. It turned out that the mechanic did not check the radio compass on all ranges nor the operation of the radio altimeter. And only after he has done all of this, did the technician decide to fill out the log.

Officer Kashkalov will not dismiss any mechanic until he has checked personally whether all jobs have been done completely, whether any tools have been left in the aircraft, and whether maintenance ports have been closed.

There are pilots who sometimes neglect to carry out preflight inspection of aircraft equipment. Let us confess that there are sometimes cases when the pilot accepts the aircraft without inspection. However, aircraft technician Kashkalov has made the occurrence of such cases impossible. This is indicated even in the form of the report:

"The aircraft is ready for flight. It's ready for your inspection, all hatches open."

And the pilot willy-nilly makes the inspection round. The technician will not close any hatch or opening until the pilot has inspected them.

The pilot cannot even enter the cockpit without inspecting it beforehand, since the hatches in the seat are open. Only after inspection of the cockpit's condition will the technician close them.

It is well known that an appropriate document demands that, if the technician discovers violations in operating an aircraft committed by flying personnel, he must immediately report this to his superiors in the Aircraft Engineering Service and ground the airplane while awaiting their decision. Life proves the necessity of strict observance of this rule. After all, when a lapse in flight training occurs, skill is lost together with time. And the technician sees quite well how confidently the pilot acts in the cockpit. If, for instance, he starts the engine incorrectly, the technician must immediately appraise the engineer of this, and the latter will find ways of preventing undesirable consequences. Of course this also has its difficulties. Imagine, for instance, a senior pilot officer sitting in the cockpit. In these circumstances not every lieutenant technician will insist on his rights.

"It happened to me too," says Kashkalov, smiling.

However he speaks of this unwillingly and laconically. This is what happened. A pilot who had an interruption in flying climbed into the cockpit. He acted without confidence. The technician noticed this and reported to the engineer. Then the commander made the decision to give the pilot additional training in the aircraft's cockpit.

Of paramount importance for the reliable operation of aircraft equipment in the air are the quality of maintenance of the equipment on the ground and consideration of the special features of forthcoming flights at night, at high altitudes, as well as those over the full radius with landing on a strange airfield, etc.

In making the aircraft ready for high-altitude flights, the technician takes into account the possibility of vapor formation on the glass of the canopy. We will not discuss the technique of drying out the space between the glass. Its essential feature is that an airfield compressed-air bottle with a pressure of 30-100 kg/cm^2 is connected to a special drying cartridge, and air is blown through the space between the glass. This however does not always offer complete assurance against vapor formation on the glass. What then is the solution? Here Kashkalov decided, in addition to using the required air drying, to seek other means. First of all, he did not wait until the silica gel turned pink in the drying cartridge, but began to change it somewhat earlier when it still had a light blue color. Approximately once a month he dismantles the drying cartridge and heats the silica gel in a special cabinet, thereby restoring its qualities. In addition, he doubled the time of air drying of the interglass space. But the airfield bottle may contain moist air. Obviously, the atmospheric conditions under which the bottles were filled in the compresser station have an influence over this. Therefore the technician as a rule uses bottles for air drying with dry air filled in good weather at low relative humidity.

Servicing of a fighter aircraft for night flights has its own peculiarities. "At night the pilot is deprived of his eyes", says Grigoriy Semenovich in a picturesque way. "Therefore the aircraft must be checked out for night missions during the day." During the preflight inspection the lieutenant technician pays particular attention to the condition of the landing light, the BANO [aircraft air navigation lights], the UFO [ultra violet] bulbs, and the cockpit lighting. The possibility of a breakdown of the UFO bulbs due to a bad contact (the red is functioning, the ultraviolet is not), is not excluded. The filament rheostat is checked to prevent blinking of the bulbs. The operation of the BANO lights must be checked also. A spare stern bulb for the BANO lights must be taken along since it fails most frequently because of strong vibrations. The mechanism of extending and retracting of the landing light must be in working order. Before the flight, officer Kashkalov reminds the pilot of the sequence of switching on the landing light.

One more detail. Prior to taxiing, the pilot signals the technician by blinking the BANO lights that the chocks must be removed. It may happen that the BANO light switch is left in the off position. In order to prevent this, Kashkalov, after the BANO operation signal, stands in the zone illuminated by them and makes sure that the BANO lights are on and signals this to the pilot with a flashlight.

Kashkalov has also special routines for servicing aircraft on a dirt field. Here the impacts which are taken up by the landing gear in landing on a dirt surface must be taken into account. For instance, play in the upper articulation of the landing gear strut may develop very rapidly. During the post-flight check Kashkalov inspects the retracting and extending cylinders of the landing gear struts and the nose-wheel steering mechanism. He looks for cracks in the strut joints, accumulation of dirt, system fluid leaks, and carefully wipes the working surfaces with a clean rag and greases them. By changing the lubricant on time in the assemblies and joints he achieves the minimum total play.

"Why do some aircraft show maximum permissible play earlier and other planes later?" the technician was asked.

"If the lubricant is changed at the proper time," he replied, "the wear on parts can be considerably reduced. After all, sand with grease is a form of abrasive. When my aircraft was delivered to the maintenance shops after 500 hours in the air, nobody could believe there that it had clocked so much flying time — so small was the wear on the parts."

The dirt airfield also has its positive characteristics. Let us consider for instance the brake system. It functions better on the dirt airfield and can be operated longer. The tires and tubes also wear longer. Of course the landing gear experiences greater loads. But the technical personnel can almost double the useful time of parts and joints if the lubricant and bolts are changed on time.

Usually difficulties are experienced in lubricating the suspension pin (especially at the VK-44 terminal switch). Kashkalov manufactured a simple device with the aid of which grease is packed simultaneously at both ends of the suspension pin. A simple matter. But the point, of course, is not whether this device is simple or complicated; it shows the great love and care for aviation equipment which Grigoriy Semenovich feels. "If one has no love for equipment, one cannot be a good technician," is his favorite saying. Indeed, any proposal by innovators, even the simplest (and it is fine if it is simple), expresses the desire to prolong the life of a combat machine.

Let us take another example. Kashkalov noticed that on takeoff the TsIATIM [Central Scientific Research Institute of Aviation Fuels and Lubricants] grease is easily blown off by a stream of air from the synchronizing cables of the wing flaps and from the pulleys. He subsequently mixed the TsIATIM grease with NK-50 lubricant. He obtained a thicker layer which adheres better to the pulleys and cables. There were opponents of this method. [They pointed out that] the outward appearance of the parts became worse — the grease layer looked dark. But the quality of lubrication improved! The mechanism began working under more favorable conditions, which increased the life of the cables and pulleys. And this is the main thing.

Finally, let us take this example. The aircraft battery has an inconvenient draining arrangement with an outlet into a compartment under the hood. Technician Lt. Kashkalov conceived a way to prevent the acid vapors from condensing on the equipment housed in the compartment. For this he discarded the nipple coupling, made the pipe longer, and brought it outside through a hole in the hood. This, at first glance, is also a very simple improvement. But that is precisely why it is valuable.

It would not be hard to continue our list, but it is not necessary. The technician must often decide on questions involving innovations and the improvement of technical maintenance methods of combat machines. Some things are almost waiting in plain sight to be picked up by skilled hands and to be noticed by a skilled eye. The more a man loves his profession, the more surely he feels in it a "vital impulse" — which is a most treasured thing and which brings his profession close to him.

When Grigoriy Semonovich's machine is brought to the TECh [technical maintenance unit] for the scheduled regulation maintenance work, the following note usually appears in the servicing log after the inspection: "No defects, the aircraft is in good condition."

The question that suggests itself is how does Technician Lt. Kashkalov bring it about that his machine is brought to the TECh without defects?

"I can't stand them, I can't live with them," says Grigoriy Semenovich.

Indeed he does not wait for special time or regulation maintenance work, but takes care of any breakdowns which occur during the preliminary servicing and during the grounded days.

But he believes that if an aircraft has come up for the regulation overhauling, this period must be utilized as fully as possible to bring the aircraft to combat preparedness. Here the possibilities of doing this are greater, since all assemblies and mechanisms are readily accessible. All that is required is sufficient time for the inspection and carrying out everything which is provided for in the unified regulation maintenance list. At the same time, the technician does not forget his role: the inspector and acceptor of all jobs done by the specialists of TECh. He tries to carry out in the fullest measure the post-inspection check on the aircraft and engine.

"Some technicians erroneously believe that the time when the aircraft is in for regulation overhauling is a time for rest. After all, TECh must repair all defects.

I, on the other hand, get very tired during this time," says Kashkalov, "because I must work quite a bit. The regulation maintenance work is, as it were, a "foundation" for the subsequent successful technical operation of the aircraft, and we all know that if the foundation is sound the building itself will be strong and will stand a long time.

By being active and creative in his work, by understanding his important role and the great responsibility for the job in his trust, officer Kashkalov has become outstanding in combat and political preparedness, has become the best aircraft technician in his unit.

Now he is being promoted to the position of flight technician.

ANSWERS TO READERS' QUESTIONS

THE INTERNATIONAL GEOPHYSICAL YEAR

Readers of the Journal, Military Pilot First Class, Maj. A. D. Yezhov, Military Navigator First Class, Capt. V. I. Bychin, and Engineer Maj. A. I. Semenovykh have asked for an explanation of the essential measures planned for the Third International Geophysical Year. We are printing below an article on this topic.

At 00 hours Greenwich time on 1 July 1957 the Third Geophysical Year began. It will run for 18 months and end 31 December 1958. It is the greatest scientific event of international scope known to history and will bring together geophysicists of scores of countries.

It became evident long ago that coordination of the efforts of scientists throughout the world was required for the solution of geophysical problems on a global scale.

Two Geophysical Polar years have taken place up to the present time. The first, organized by a decision of the International Meteorological Congress in Rome, took place from August 1882 to August 1883. Twelve countries participated in it. Twelve expeditions to the Arctic and two to the Antarctic were organized.

The International Commission, to which Academician A. P. Karpinskiy was elected as the member from the Soviet Union, worked out a program of scientific observations for the Second International Geophysical Year conducted in 1932-1933. This time, in addition to meteorological and magnetic observations, aerological data were collected as well with the aid of radiosondes in Tikhaya Bay, at Matochkin Shar, and at Polyarnyy.

If traditions were to be observed, the next regular International Geophysical Year would take place in 1982-1983. But the rapid development of science and technology in the last two decades, the tremendous strides in the development of aviation, radio, and radar, as well as the increased demands on weather forecasting — in particular on long-range forecasting — led to a situation which made it impossible for the geophysicists to wait that long. And in 1950 a mixed committee on the ionosphere made a proposal to the International Council of Scientific Societies on the organization of the Third International Polar Geophysical Year in 1957-1958, i. e., 25 years after the Second.

The main task of the Geophysical Year consists of solving the problems of geophysics of global character, which either cannot be solved by scientists of one country or necessitate the setting up of coordinated and simultaneous observations over practically the entire globe. New stations, observatories, and special scientific expeditions have now come into being. The net of meteorological, aerological, and other stations on the meridians of 10°, 75°, 110°, and 140° East Longitude. and 80° West Longitude has been reinforced. Special importance is attached to the observations made near the equator.

The program of scientific research of the International Geophysical Year is quite diversified. It encompasses such branches of geophysics as meteorology (physics of the atmosphere), the ionosphere, geomagnetism, solar activity, the aurora borealis and light emission by the sky at night, cosmic radiation, glaciology (study of ice), oceanography, seismology, gravimetry, variations in latitude and longitude, etc.

We will discuss only that part of the research program which is most vital to aviation.

Study of Wind Conditions at High Altitudes. The radiological net, in which temperature, pressure, humidity, the direction and speed of wind at high altitudes are measured by radiosondes, has undergone extensive development in postwar years.

The radiological net in existence on the globe, supplemented by special stations, will make it possible to obtain data during the International Geophysical Year for the study of the characteristics of the overall circulation of the atmosphere at different latitudes — in particular over the Antarctic; it will also make it possible to trace the exchange of air masses between the Southern and the Northern hemispheres and to study other phenomena and processes. All of this is quite important for long-range weather forecasting.

For the first time it will also be possible scientifically and practically to compile detailed high-altitude weather maps for the entire globe, an extremely necessary step, not only for the study of the overall circulation of the atmosphere, but for the daily services rendered the international air lines as well.

Among the problems of overall circulation of the atmosphere, the study of jet streams (by jet stream is meant a comparatively narrow region of strong winds stretching over great distances in the upper troposphere and the lower part of the stratosphere, structurally connected with regions of great temperature contrasts) has considerable importance. Tropospheric jet streams, sometimes spanning the whole globe, are located at an altitude of 9 - 12 km, have cross-sections of 300-400 km, and occasionally as much as 1000-1500 km, and a thickness of 2-4 km. The greatest wind velocities are observed along the axis of such streams; these reach in certain instances — especially over Japan — a velocity of 150 m/sec and more. The wind velocity drops off in the radial direction; due to this great horizontal (up to 35-55 km/hr for 100 km) and vertical (up to 5 and more m/sec for 100 m) shifts in the wind are encountered in the jet streams. They lead to the development of atmospheric turbulence in these regions, which puts excessive stresses on aircraft and complicates flying them. Turbulent zones, which are most frequently 300-600 m thick and 50-100 km long, are distributed in the jet stream in the form of random "spots". They can be avoided if flight altitude is somewhat altered.

Jet streams are of great practical importance for aviation. Flying along the stream axis in the direction of the wind sharply increases flight speed. With head winds, it is advisable to move aside or change altitude, and the flight will take place with wind of moderate force. This can yield considerable economy in flight time and fuel consumption.

A jet stream with a velocity of over 100 km/hr is always in existence somewhere

between 70° and 35° North Latitude, especially in the winter. In the troposphere, at moderate and high latitudes, jet streams are associated with frontal activity. They are usually located in the warm air, in the sector between the frontal zone and the high tropopause (the transitional zone between the troposphere and the stratosphere). Jet streams in the troposphere at subtropic and equatorial latitudes, as well as in the stratosphere, are apparently not connected with fronts and are called frontless.

In January and February of 1956, 20 radiosonde balloons were launched from the islands of Japan (the city of Ohama). Some balloons, carried by jet streams of moderate latitudes (at an altitude of 9 - 10 km) reached the western shores of Europe (across the Pacific Ocean, the American continent, and the Atlantic). The maximum length of their journey was 26 thousand km, the duration of flight 128 hrs, and the speed on some legs was 460 km/hr (the average: 160 km/hr). The highest speed was observed during the flight of one of the balloons on the meridian of 160° West Longitude. It must be pointed out that a rather important characteristic of the jet stream is the "spot-like" (focal) character of the distribution of velocities along the stream axis. However, the formation, growth, and disintegration of the foci with high wind velocities have not yet been studied to a sufficient extent.

Subtropic jet streams, which change their geographic position only slightly, have a width of 800-1000 km. The axis of these streams is at an altitude of 12-14 km; in the summer they are displaced somewhat north as compared to their position in the winter.

Stratospheric jet streams have been studied the least. Contradictions in data on them are due to the difference in the completeness and quality of observations available to workers in the field. Disagreements in conclusions exist not only on this question. For instance, some have discovered an equatorial jet stream, whereas others are of the opinion that it does not exist.

The International Geophysical Year will make it possible to understand and resolve the contradictions in the study of jet streams.

This applies no less to the study of wind conditions in the upper layers of the atmosphere, about which information is still scarce. Rocket observations, as well as the study of the movement of silvery clouds (80-85 km) and meteor traces (30-120 km), of the non-homogeneity of the ionosphere (above 100 km) will permit a considerable widening of our knowledge in this area, which is of great importance for aviation and rocket technology.

Study of the Composition of Air. It has been definitely established at the present time that the composition of air, as far as its main components (nitrogen and oxygen) are concerned, is the same as that at the surface of the earth up to 80-90 km. But from 80-90 km the dissociation (breaking up) of oxygen molecules into atoms takes place.

According to calculations, the concentration of atomic oxygen must increase with altitude (from the level of 90 km) according to an exponential law. At an altitude of 130 km the content of atomic oxygen must amount to 73%; at an altitude of 140 km, to about 87%; and at an altitude of 160 km, to about 92% of the total content of oxygen. It is assumed that the upper limit of the dissociation layer is located at an altitude of 200 km, where at least 98% of molecular oxygen undergoes dissociation. At greater altitudes, the oxygen is in the atomic state. The practical importance of this phenomenon is in the fact that energy is released as a result of dissociation of oxygen molecules into atoms. Is there a possibility of utilizing it for power plants and flying apparatus? This problem has already been put on the agenda.

Rather contradictory are present-day data on the dissociation of nitrogen molecules. Its dissociation begins presumably at an altitude of 220 km. The concentration of atomic nitrogen increases also exponentially with altitude, but slower than that of oxygen. Therefore, up to high altitudes both molecules and atoms of nitrogen can be encountered. Verification of these ideas, formed as a result of theoretical studies and the analysis of data from the few rocket and other type of observations, is of vital importance, since this determines the change of the molecular weight of air with altitude and the change in atmospheric pressure. The temperature conditions at high altitudes are connected with the process of dissociation, caused by the absorption of short-wave solar radiation.

The question of the altitude of the threshold of separation of gases is as yet unresolved. Mass-spectroscopic measurements have shown that the ratio of the amount of argon to the amount of nitrogen remains unchanged up to an altitude of 137 km. Thus the separation of gases by diffusion is absent up to this altitude. On the other hand, mass-spectroscopic measurements of the ratio of the amount of argon to the amount of nitrogen remains unchanged up to an altitude of 137 km. Thus the separation of gases by diffusion is absent up to this altitude. On the other hand, mass-spectroscopic measurements of the ratio of the number of light nitrogen molecules to the number of heavy nitrogen molecules points to a separation threshold at an altitude of 40 - 50 km. In five cases the concentration of lighter nitrogen molecules increased with altitude and the maximum increase in the 40-60 km layer reached 3.9%. New observations will resolve the question of separation of gases in atmospheric layers at high altitudes.

During the International Geophysical Year much attention will be paid to the study of ozone. The content of this gas in the earth's atmosphere is not high. But ozone is very important for many processes in the atmosphere. It screens the earth from solar ultra-violet radiation harmful to living organisms, protects the earth from the loss of longwave radiation, and is responsible for the existence of a warm layer of air at altitudes of 40 - 60 km. The greatest concentration of ozone is observed at altitudes of from 14 - 16 to 30 - 35 km with the maximum at altitudes of 25 - 28 km. Above 25 - 28 km the content of ozone decreases almost exponentially; at altitudes in excess of 70 km it is negligible.

To explain the causes of the change in the content of ozone, a special network is being set up for the duration of the current Geophysical Year in the USSR, Italy, England, India, Pakistan, Germany, and other countries. Launchings of special instruments by rockets will also be used to study the ozone content.

Observation of Temperature and Density of Air at High Altitudes. Sound-ranging observations in the Arctic during the Second International Polar Year have shown that the temperature of air increases with altitude in this region of the globe as well, beginning at 30 - 35 km and reaching its maximum at an altitude of about 50 km. In recent years in the course of rocket observations these results were confirmed for different latitudes right down to the equator. Above 50 km, the temperature of the air decreases again and reaches its minimum at the upper edge of the stratosphere, i.e., at an altitude of about 80 km. The temperature at higher altitudes has been investigated experimentally very little.

The extensive program of rocket observations being organized at many points on

the globe will make it possible to check and correct the data on temperature of the air at high altitudes, as well as to study its spatial and temporal variations. This should be supported by launchings of earth satellites. Air temperature at high altitudes will be determined by other methods as well: by the attenuation of radio waves, the distribution of the electron density at high altitude, by the spectra of the aurora borealis.

Measurements of pressure and density of air at high altitudes are also very important for aviation. Calculations show that air density in the upper layers of the atmosphere can be "sensed" by flying apparatus. Knowledge of the true density of air at high altitudes is quite important for future flights by jet and rocket aviation.

Studies of the Ionosphere. The ionosphere is a layer of the atmosphere which is located above 100 km. It has high electrical conductivity and is a good reflector of comparatively long radio waves. It is this very capacity of the ionosphere to reflect radio waves which makes it possible to have long-range radio communication on waves which are propagated around the globe between the earth's surface and the ionosphere.

The ionosphere has a rather complicated vertical structure. It was thought up to now that it consisted of several separate layers. However, rocket observations in recent years have shown that the ionosphere can be regarded as one layer with local and comparatively small variations of electrical conductivity. During the Geophysical Year observations of its properties will be continued, and this will permit a considerable clarification of our ideas of it.

Extensive studies of the relationship between the condition of the ionosphere and solar activity are proposed.

Scientists will follow the relationships between the electrical properties of the ionosphere and its other parameters. This is all very important for perfecting techniques of forecasting the weather and the conditions for radio communication at low and high altitudes.

In the studies now in progress, aviation plays a rather important role by aiding the scientists in solving the general part of the entire scientific program, as well as a whole series of specific problems which are of the greatest immediate interest, not only for the near future of aviation, but also for the present. It is quite clear that the studies of wind conditions at high altitudes, the studies of air composition, the observation of air temperature and density at high altitudes, etc., are all conducted with the widest participation of aviation, and are, in turn, directly related to its problems, to the future development of flight at high altitudes and in the stratosphere.

Even in the period of preparation for the International Geophysical Year, aviation enabled scientists to have access to the impenetrable pole. The flight to the geomagnetic pole was successful. Planes and helicopters were used in investigating terrestial magnetism, for astronomic and navigational studies, etc. Now this work continues on a yet wider scale.

Doctor of Physical-Mathematical Sciences
N. Z. Pinus

FROM THE HISTORY OF SOVIET AVIATION

HOW PROBLEMS OF AIR NAVIGATION USED TO BE SOLVED

Lt. Gen. of the Air Force B. V. Sterligov (ret.)

At present hardly anybody is impressed by reports of intercontinental, transoceanic, transpolar, and other long-distance flights, which have become an ordinary, every-day occurrence. Neither the time of day, nor the weather, nor the character of the terrain, nor, finally, the distance itself presents an obstacle for modern aircraft in flying to any point on the globe — and this at any time.

Aviation has achieved these capabilities in an incredibly short time — in something like a half of a century — thanks to the successes in aircraft construction and the development of air navigation and its technical facilities.

As far as our Soviet Aviation is concerned, history put, as is well known, even less time at its disposal. It must be remembered that the beginning had to be made almost from scratch, after the conclusion of the Civil War and the victory over chaos. However, creative conditions of the Soviet Socialist regime have enabled our aviation, in particular the Soviet school of air navigation, not only to catch up with the countries leading in aviation in 15 to 20 years, but to surpass them in a number of important factors.

It has been my privilege not only to witness the development of the Soviet school of air navigation, but to take part in this important task.

Meteorology or Air Navigation? The first scientific organization to deal with the problems of air navigation, the Central Air Navigation Station (TsANS), was set up in April 1923 in Moscow. In the beginning the station dealt not with air navigation, but rather with air meteorology, since its head, Professor V. I. Vitkyevich and many of the officials of the Glavvozdukhoflot [Main Administration of the Air Fleet] thought at the time that air navigation is a sort of application of meteorology to aviation. The training of air navigators in a school of special services was conducted from this point of view. The graduates of the school were at the time appointed heads of air navigation (but in reality meteorological) stations of air units; they themselves never flew, but only provided flying personnel with data on meteorological observations, calculations, and recommendations.

However, from the first days of the existence of TsANS there began a struggle between the proponents of the two concepts of the role of navigation: the one discussed above and our present concept of air navigation as a science applying directly to flying, later termed air navigation. This term was proposed by me on the analogy of marine navigation. The struggle was concluded in January 1925 by dividing TsANS into two autonomous parts: the Service of Air Currents, subsequently

TsAMS [Central Air Weather Service], later GAMS [Civil Air Weather Station]) and the Bureau of Air Navigation (ANB, later ANO [Air Navigation Section] of the NII [Scientific Research Institute]).

Originally the ANB consisted of 3 people: N. N. Kurbatov, B. V. Sterligov, and Ye. A. Danilin. Later S. A. Nozdrovskiy, I. T. Spirin, S. A. Danilin, G. S. Frenkel', S. S. Tikhmenev, G. V. Korenev, D. B. Pebart, and others, joined the ANB. January 1925 can be regarded as the opening date of systematic research activity in air navigation.

It must be remembered that in those years our line air units, small in numbers, were armed with foreign aircraft of different types with rather motley and makeshift equipment. The first nine aircraft of the type R-1 were delivered by our industry only in 1924.

Route flights were carried out almost exclusively by visual reference. In short, our Air Force flying personnel still entertained pre-revolutionary notions about air navigation, most graphically expressed in the "Short Guide for Pilots" written by Military Pilot Rudnev in 1912. "The main characteristic of orientation from the plane is the fact that no compass is used in flight in the majority of cases, and the orientation is effected by using local objects". This sounds strange now, but in those days such an opinion was justified because many of the attempts at flying a more or less considerable leg of the route by compass ended not infrequently in the loss of orientation. This occurred because of crude instruments — especially compasses — and also because it was impossible to compensate in flight for the wind whose influence at flight speeds of 100-120 km/hr was very strong.

Flights by compass. The first task we assumed was to convince ourselves and to prove to the entire flying personnel the possibility and advantages of flying a route not by landmarks but by compass. How naive this problem seems now! But at that time it was very serious to us; the fate of air navigation depended on its solution. All pilots and aerial observers with experience in long-distance flying ridiculed this project. After all, there have been long-distance flights, and what flights! For instance, the flight by a group of Soviet pilots including M. A. Volkovoynov, M. M. Gromov, and others over the Moscow-Peking route in the summer of 1925.

Even though these flights were planned in our ANB, they were carried out in the old proven method: the flights took place in good weather, along linear check points with no navigator aboard.

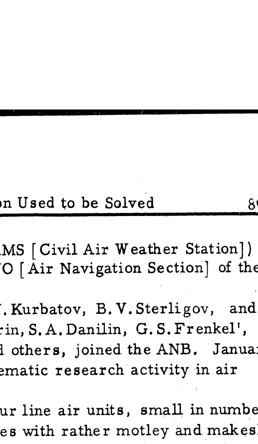


Fig. 1. Aircraft navigational sighting piece ANB-1 and wind computer (1925).

The campaign for air navigation by compass began with a sort of reconnaissance. The trial route flight by compass was carried

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/10/31 : CIA-RDP81-01043R002400050009-7

out with the course calculations made prior to takeoff and based on data furnished by weather balloons. This was the flight, prepared by our ANB, of pilot F.S. Rastegayev and aerial observer N.N. Kurbatov in March of 1925 in an R-1 aircraft over the Moscow-Smolensk-Leningrad-Moscow route. As was to be expected, on each leg, shortly after takeoff, the crew was compelled to resort to orientation by landmarks. It became clear to us, that flight by compass was contingent above everything else on the possibility of determining and allowing for the wind in flight.

It meant that it was necessary to transfer air navigational measurements and computations from an air navigation station to the aircraft, and, above all, to develop and design the instruments required for this task. For this purpose an aircraft navigational sighting piece ANB-1 (Fig. 1) was designed by S. A. Nozdrovskiy to measure the angle of drift and the ground speed, while I designed a new wind computer to replace the wind computer designed by N.F. Kudryavtsev.

In addition to this, we developed special nomograms (navigrams), later replaced by the well-known navigational rule, to simplify and expedite in flight the calculations of corrections of instrument readings (altitude and speed).

Finally everything was ready and on 3 June 1925 pilot M.A. Volkovoynov and aerial observer B.V. Sterligov made the first flight by compass over the Moscow-Klin route, determining the course in the air. The route, as we see, was not long. But this flight marked the beginning of experimental route flights over distances of 100-150 km in different directions from Moscow. The accuracy of air navigation by compass proved to be at that time equal to 3% of the length of the route.

By the summer of 1926 we had completely mastered air navigation by compass by day over any terrain. We were facing the task of imparting our experience in the most rapid and convincing manner to the line units of the Air Force. For this purpose, in the period from 27 July to 9 August 1926, pilot V.O. Pisarenko and I flew an R-1 plane exclusively by compass over a 3000 km Moscow-Khar'kov-Rostov-on-the-Don-Sevastopol'-Kiyev-Moscow route. The aircraft landed only at the points named, which meant that the flight was carried out to the limit of the technical range of the aircraft (800 km). For instance, the length of the Kiyev-Moscow leg was 740 km, and the Rostov-on-the-Don-Sevastopol' leg entailed a flight of 230 km over the sea in order to reach Sevastopol' without landing at an intermediate point.

For the first time the following items made their appearance in the cockpit of the navigator: the compass, the speed indicator, the altimeter, the watch with a timer, the ANB sighting piece, the ANO wind computer, tables of navigrams, the plotting board with a log and a map (25 versts to 1 inch). A large outside air thermometer was placed on the aircraft strut. In the pilot's cabin were placed the compass, the speed indicator, the altimeter, the bank and turn indicator. The pilot did not have a map and flew the plane strictly over the course plotted by the navigator. This last was the most convincing circumstance for the air garrisons along our route as well as for V.O. Pisarenko himself. This old "air wolf", was one of the staunchest opponents of flights by compass before the flight; but after it he became an enthusiastic propagandist of the method. In an article "3000 km by Compass" ("Herald of the Air Fleet", No. 10, 1926) the flight was treated in detail.

Successful completion of the first real air navigational flight permitted us to consider the problem of air navigation by compass in the daytime as solved by the end of 1926.

Piloting by Night. In October 1926 our ANB was reorganized into the Air Navigation Department of the NII of the Air Force (ANO of the NII), which was expanded and provided with new equipment. Our ranks were joined by L.P. Sergeyev, A.N. Volokhov (astronomers), S.S. Tikhmenev, G.V. Korenev, V.M. Tryakin (instrument specialists), and others. I was appointed head of the ANO.

This team commenced the study and trials of air navigation at night. The majority considered night flying impossible and — what was more important — useless for military applications. But some experience in such flying existed in the aviation of our country, an example being the flights by "Muromets" aircraft in the first world war.

It was clear that we could concentrate on this matter in practice only after the pilots had mastered takeoff, landing, and night flying over the airfield.

Having invited several pilots who had mastered takeoff and landing at night by floodlights, we commenced night flying over the airfield in the winter of 1926-27 in order to test the instruments designed to measure navigational elements at night, to adjust their illumination, to check the visibility of ground check points from different altitudes on moonlit and dark nights. Besides myself, I.T. Spirin and S.A. Danilin took part in these flights.

And finally on 22 June 1927 pilot I.F. Kozlov and I made the first route flight by compass in an R-1 plane from Moscow to Serpukhov on a dark night. We landed in Serpukhov with the aid of three bonfires and returned the same night. Then began a series of short route flights at night to practice the different elements of night piloting.

In July 1927 V.O. Pisarenko and I made a night flight by compass from Moscow to Smolensk and back (with a landing at Smolensk). The night was dark, with thundershowers. We approached the airfield and landed without any light beacons or floodlights, and with only three bonfires. Despite the late hour, the entire Smolensk air garrison met us at the airfield. "Sojourning" in Smolensk, we flew back to Moscow the very next night. The problem of night flying had been solved and we gained complete confidence in the reliability of navigation at night by compass.

To propagandize the feasibility of night route flying among the flying personnel, we took part in the Odessa air maneuvers in the fall of the same year.

The flight to the maneuvers over the Moscow-Khar'kov-Odessa route was accomplished by Pisarenko and myself at night. In Odessa our aircraft was visited by numerous groups of flying personnel. Here the training in piloting at night was conducted as well (Fig. 2).

During maneuvers we flew night reconnaissance against cavalry and against a naval landing force of the "Blues" en route to Odessa from Sevastopol' at night. The naval landing force was discovered by us 200 km off shore. The "Red" side was given a report on this.[1]

It now became clear that night route flights were not only possible, but quite useful in a military sense.

Over the Sea. Simultaneously with the solution of the problems of night navigation, the development of means and methods of navigation over the sea was undertaken in our country.

This necessitated first of all a development of the means of determining the drift

[1] B.G. Ratts had already performed a successful trial reconnaissance of ships at night in 1926 and had discovered them 60 km from shore.

Fig. 2. Piloting and navigational equipment of the R-1 aircraft 1-pilot's compass; 2-speed indicator; 3-altimeter; 4-clock; 5-turn and bank indicator; 6-11 engine instruments; 12-panel light; 13-main compass;14-speed indicator;15-altimeter;16-clock with a timer;17-base of the sighting piece; 18-sight of the OPB-1 type [optical bombsight];19-20-correction charts;21-navigational instruments; 22-wind computer;23-plotting board with a map;24, 25-light switches; 26-intercommunication device;27-ANB sighting piece;28-sextant;29-astrocomputer.

angle and ground speed over the sea. In 1927 G. S. Frenkel' and S. A. Danilin designed a small navigational dye marker bomb which produced a stable color stain on the surface of the water and, later, an ANO night navigational sea marker bomb.

G. S. Frenkel', I. T. Spirin, S. A. Danilin, L. S. Popov, B. G. Ratts, took part in trial flights over the sea. The navigational rule proposed in this period by Com. Popov soon rapidly supplanted the "navigrams"; with some modernizations it is to the present time regulation equipment of every navigator and pilot.

Transition to flights over water caused the Soviet navigators to speed up the testing of astronomic orientation. In 1927 the methods of nautical astronomy were simplified so as to be applicable to flying conditions. Astrographs were developed to determine latitude and longitude by the North Star, together with a portable map of the celestial sphere. In the summer of 1927 the head of the astronomical group of the ANO of the NII, A. N. Volokhov succeeded in taking the first celestial fix in flight. After a two-hour flight in an unknown direction he piloted the aircraft to Moscow along a transferred line of position. L. P. Sergeyev participated in and carried on the work in aerial astronomy; he is the author of the first manuals and of a series of devices and instruments for astronavigation.

Thus, the problem of air navigation by day and at night over land and sea had been solved both in theory and in practice by the end of 1927. This experience was being passed on to the training institutions and combat units and soon became known to the entire flying personnel.

Hand-in-hand with test flying, the testing of various piloting, navigational and engine instruments proceeded in the laboratories of the Air Navigation Section under the direction of S. S. Tikhmenev and G. V. Korenev; tactical and technical standards were developed for aviation instruments made in our country.

In spite of this, air navigation was still subject to the almighty weather. We could not achieve long-range air navigation out of sight of the surface of the earth (or sea), and were not only unable to fly along a route, but were even unable to stay in the cloud cover.

A difficult task presented itself to us: to master air navigation in the cloud cover, or, as it was then said, to master "blind flying".

Air Navigation in the Cloud Cover and Above the Clouds. Before undertaking air navigation in the cloud cover it was necessary to teach the pilots to fly the aircraft on instruments only, i.e., blindly. This is where the difficulties arose. Many pilots who made unsuccessful attempts to maintain equilibrium in the cloud cover, denied the feasibility of flying therein. Some talked of a special sense, with the aid of which they were successful in passing through clouds in a "normal fashion".

All debates were ranged around the turn indicator, which was erroneously called a course holder. This instrument was purchased abroad and installed on the aircraft in order to maintain course more accurately during bombing runs. The debate was over the question whether it was possible to keep on course in the cloud cover with the aid of this instrument.

After analyzing the theoretical side of this problem and the characteristics of the "course holder", we realized that the instrument allowed us in blind flight to maintain, not the course, but to coordinate the turn with the bank, i.e., it allowed us to solve the most difficult problem in piloting out of sight of the horizon.

The first man to undertake to prove to the pilots that it was possible to fly in the cloud cover with this instrument was F. G. Fedorov. He went up on 1 November 1927 and several times passed through a huge cumulus cloud formation. The aircraft made normal exits from the cloud cover, the pilot kept the ball of the bank indicator centered, and the turn indicated by the gyroscope pointer was countered by "backpedaling". This was followed by intensive flights in the cloud cover — at first in the airfield zone.

Later, closed cockpits were developed for training pilots, and training manuals on the technique of blind piloting were written. K. I. Trunov played a major role in this undertaking.

And finally in February 1928 S. A. Danilin with Pilot Zh. Puantis completed the first flight in the cloud cover in a specially equipped aircraft over the Moscow-Kashira-Moscow route. This was a great victory. The absolute feasibility of air navigation in the cloud cover out of sight of the ground with infrequent and brief exits from the clouds for checking the route had been proved.

It is interesting to note that reliable and rather precise air navigation in the cloud cover was achieved even without radio navigation. The accuracy of blind navigation allowed me to propose bombing on the basis of time computation, i.e., to impart actual combat meaning to blind flights. This proposal was put into practice and yielded excellent results.

The Moscow-New York Flight. By the summer of 1928 all methods of navigation possible at the time were tried under the most diverse conditions, including blind flying. Our Soviet air navigation not only became self-sufficient, but in many respects left other countries behind. We began a systematic presentation of the theory and experience of Soviet aviation in the field of air navigation. The book "Guide to Air Navigation" was written by G. V. Korenev, G. S. Frenkel', A. N. Volokhov, and myself in a year and a half and appeared in print at the beginning of 1930.[2] This book contained only the methods and procedures of air navigation under various conditions tested in practice, and served as a source for writing textbooks, instructions,

2 A similar instruction book was published in the USA in 1931.

combat training programs and directions for the Air Navigation Service of the Air Force.

In order to make the final verification of the theory and practice of air navigation developed in our country, we worked out a plan for a flight from Moscow to New York via the Far East over a distance of 22,000 km in the new twin-engine all-metal TB-1 aircraft designed by A. N. Tupolev.

On 1 November 1929 the aircraft, which was given the name "Country of the Soviets", manned by pilots S. A. Shestakov and F. Ye. Bolotov, navigator B. V. Sterligov and flight engineer D. V. Fufayev, landed on an airfield in New York after a flight over an as yet unexplored route through all of Siberia and the Far East, the Sea of Okhotsk and the Bering Sea and the entire North American continent.

This flight was described in our press. From the standpoint of air navigation, of special interest was the route between Petropavlovsk-on-Kamchatka and the island of Attu, 1100 km in length (the range of a hydroplane was only 1250 km). The island was only 10 km in diameter. This hop had been successfully completed with the aid of astronomical orientation, which required our climbing above solid cloud cover. Also rather interesting was the flight across the Cordillera, over which we flew at the aircraft's ceiling.

Since our flight to New York, which demonstrated to the whole world the rapid rise of the power and the maturity of Soviet aviation, of the Soviet aircraft industry, and of our school of air navigation, the navigator has had an important place aboard every aircraft taking off on a long flight. For example, as early as September 1930, a group of R-5 aircraft sent to Turkey and Afghanistan was led by our navigator I. T. Spirin.

Group Navigation. In conjunction with the qualitative and the quantitative development of our aviation, there arose the problems of leading large groups of aircraft of various application. In the spring of 1930 the government decided to have an air parade over Moscow on 1 May. Our ANO was given the task of assembling a large group of aircraft (over 300) of different types and getting them to the Red Square in a given parade formation at a very definite time. This of course, included the task of calculating and organizing the landing of a large number of aircraft on each airfield, which was complicated by the limited fuel supply of the fighter aircraft.

At that time, a group of aircraft, taking off from one airfield, would simply assemble in a circle. This method was acceptable for a small group (not more than a squadron). After some calculations, I proposed the loop method. It enabled us to assemble any group of aircraft in a desired order, to lead it to a given point at a given time, and to land it on one airfield in a minimum of time.

Tests of the new method were conducted for 2 or 3 weeks; then the pilots were given the required training. The aerial May Day parade of 1930 was successful. Since then the loop method, now well known to every navigator and pilot, has received wide application.

The proposed methods and means of group air navigation received their finishing touches in 1934 during special training exercises for heavy aviation. Members of the ANO, in cooperation with Air Force specialists, trained the pilots and navigators of our heavy aviation units in flying in full formation at maximum radius in the daytime and at night over sea and mountains.

Radio Navigation. In the meantime, a new navigator discipline — radio navigation — began its rapid development. Radio beacons had been tested in our country and were installed on the territory of our country under the direction of P. A. Stolyarov. In the summer of 1930, pilot V. M. Zhernovskiy made the first blind landing in an U-2 aircraft with an antenna designed by S. A. Danilin. The forerunners of radio compasses, aircraft radio direction finders, made their appearance on heavy aircraft; much effort was expended by L. L. Kerber on the testing and introduction of this equipment. A group of engineers from the ANO designed a gyromagnetic compass. In 1932 N. A. Korbanskiy developed a radio compass of original design.

The "Manual for the Air Navigation Service" (NANS-32) which became one of the basic Air Force texts on air navigation, was written in the ANO.

Prior to 1930 air navigation in the USSR was being developed mainly for two-place or multi-place aircraft with a navigator aboard. But already in 1931 the first manual was published on "Navigation of a Single-Place Aircraft" by I. T. Spirin which became the foundation of this important field.

By the end of 1935, the navigator's work reached a high degree of perfection and became the domain, not of isolated individuals, but of whole units and commands. This was one of the most important conditions which permitted the completion of a number of record transarctic flights.

The navigational aspects of all these flights were handled in the ANO of NII; the flights confirmed the correctness of the theory and practice of the Soviet navigator's work.

Combat Proving. Intensive work was done in the ANO of NII, renamed the Navigation Section, on further improvement of the navigation service. Radio compasses, autopilots, astronomical and other instruments were designed and adopted, the methods of their application were developed.

The combat actions against the White Finns in the winter of 1939-1940 put the most modern equipment and navigational methods to the test. A special air regiment under my command was formed on the Leningrad front. The aircraft of this regiment were fitted out with our latest equipment, including equipment for blind landing. The entire flying personnel had absolute command of the technique of blind flying. Specialists from the Navigation Section occupied key instructor positions.

The crews engaged in continuous military actions by day and night in the worst weather. The superiority of the regiment over the ordinary unit can be seen from the fact that out of 73 calendar days we flew during 68, with only 5-6 calendar days of interruption for servicing of the equipment and rest of the flying personnel. The neighboring units in the same period flew only 6 days because of the weather.

Somewhat later one more such group was formed under the command of I. T. Spirin.

A new service of radio-light beacon aid to navigation the ZOS [ground aids to navigation] service, headed by V. Ya. Kravets, was created in our group. As is well known, it played an important role in aiding air navigation in the Great Patriotic War.

The experience of combat operations made it possible to rewrite and publish a new manual (NShS-41 [Navigation Service Manual]) which our Air Force used during the Great Patriotic War.

At the same time the Navigation Section furnished all the required basic data for the system of airborne and ground equipment, as well as for the training courses and programs of navigator training in the Air Force.

In order to evaluate the degree of development of Soviet air navigation from the contributions of the ANB-ANO and the Navigation Section of the Scientific Research Institute (NII), it is necessary to analyze the main factors in this development.

The first is the accuracy of navigation. It increased continuously and at present exceeds many times the accuracy we had in the beginning. The second factor is to what degree flying depends on the time of day and the weather. From about 1927, night route flights commenced — but only in good weather. After 1932 it became possible to fly in the cloud cover and above the clouds — at first only in the daytime, later also at night. However, the landing area had to be "open". Finally the long-distance flight of Yegorov and Akhapkin in 1937 proved the possibility of blind flight from takeoff to landing.

Fig. 3. An approximate picture of the decrease of the dependence of flying on the time of day and the weather.

If mean annual daylight is assumed to be equal to mean annual darkness and the annual number of days with overcast for our middle zone is assumed to be 50%, we can construct the diagram shown in Fig. 3. It illustrates the growth of independence of route flights from the time of day and the weather.

In addition to these two factors, another factor is of obvious interest to the history of the Navigation Service. This is the degree of reliability of air navigation. Its measure is defined as the number of flights per one occurrence of loss of orientation. This reliability increased systematically and, after a brief drop in the first months of the Great Patriotic War, rose again; and by the end of the war it exceeded the pre-war level several times.

In the post-war years, with the development of jet aviation and the increase in velocities and altitudes, the means of navigation were also perfected. At the present time a large number of highly trained specialists in navigation, drawing support from the mighty industry of our Soviet Motherland, advance this most important service to aviation, ensuring high accuracy of air navigation and the possibility of flight independent of the time of day and the weather, in the cloud cover or above it.

MOSCOW-TOKYO-MOSCOW

On 20 August 1927 at 0300 an aircraft designed by A. N. Tupolev, the ANT-3, named "Our Answer", rose into the air from the Moscow airfield. Pilot S. A. Shestakov and flight engineer D. V. Fufayev set out on a long transasiatic Moscow-Tokyo-Moscow flight.

Nothing complicated the flight to Irkutsk. Thereafter began the most difficult leg of the route. The flight took place in a thunderstorm, under pouring rain and

S. A. Shestakov (1927)

with a strong head wind. Especially difficult was the flight over the Baikal.

It is characteristic that the route to Blagoveshchensk (8000 km from Moscow) was covered in less than a week, which at that time represented a great achievement. Sometimes the aircraft flew with a speed in excess of 280 km/hr. On the route from Spassk, a typhoon struck and Shestakov was forced to climb to 1800 m. The Soviet aircraft and engine proved their excellent qualities; the crew performed their task brilliantly.

On 1 September 1927 the ANT-3 landed in Tokyo on Tachikawa airfield. The Soviet airmen were enthusiastically greeted by the Japanese people. The Japanese press gave much coverage to the flight by Shestakov.

On the tenth day, S. A. Shestakov took off from Tokyo on the return trip, which proved to be no less difficult. From Tokyo, the aircraft was headed for Osaka. There, such violent typhoons occur in September, that even the experienced Japanese fishermen do not dare to put out to sea. But this did not stop the Soviet airmen. They were able to overcome all of the difficulties of the flight.

The aircraft "Our Answer" landed during the day of 22 September on the Moscow airfield. Thousands of Muscovites greeted the courageous airmen.

"There were many difficulties during the flight", S. A. Shestakov told the crowd. "We flew to Tokyo in 11 days, during which I slept only 40 hours, and flight engineer Com.Fufayev half of that...

"I have not done anything which any other Soviet pilot would not have done".

The participants of the flight photographed against the aircraft "ANT-3".

The entire length of the flight — 20,000 km — was flown in 153 flying hours. The following detail is noteworthy. The life of the 400 hp M-5 engine was estimated to be only 70 hours. Therefore a second engine was shipped to the Soviet airmen at Tokyo for replacement.

But they decided to replace the engine on Soviet territory, and later took a chance on flying on to Moscow on the old one. The engine stood the test excellently: instead of 70 it had worked for 153 hours.

The Moscow-Tokyo-Moscow flight was of great importance. It proved that the series-production of aircraft of Soviet design satisfied the most stringent requirements of aviation engineering of that time. This brilliant flight was a demonstration of the success of Soviet aviation, achieved by the Tenth Anniversary of the Great October Socialist Revolution.

The Soviet Government gave high recognition to the achievements of S. A. Shestakov and D. V. Fufayev, who wrote a glorious page in the history of our aviation. Both were awarded the Order of the Red Banner.

In the years of the Great Patriotic War, Col. Semen Alexandrovich Shestakov — commander of a Guards air regiment — fought heroically against the German-Fascist aggressors. In August of 1943 he fell during a battle with twenty "Messerschmitts", to the end discharging his duty to the Motherland of defending the great achievements of October.

SKILL BORN IN THE QUEST FOR THE NEW

M. Ya. Yelenin

Spring, 1929. The sun and the sea are shining. The instructor, Vasiliy Stepanchonok, an expert pilot (subsequently a test pilot and Hero of the Soviet Union) is doing most of the talking. Ivan Polunin, a broad-chested man with jetblack hair tossed back, a graduate of the Kachina Air Force School, listens attentively.

"Go about your work in a creative way. Do you understand?"

Polunin nodded his head.

"In every flight, look for something you didn't know before. Otherwise flying is uninteresting. I think it's more useful to watch someone else's aerial combat attentively than for a man to carry on his own aerial combat in a cut-and-dried way.

The instructor pilot's eye flashed with challenge and enthusiasm.

"In general, if you go along the beaten track, you'll see only what others have already seen..."

Three years after being graduated from school, Polunin is the commander of an Air Force detachment in Belorussia. He himself flies excellently and he teaches his men skillfully, trying to find the "bottom" in every element of flying. Polunin tries to "squeeze out" of a machine everything that it can give. But he is also attracted by the technique of flying itself, by the opportunity to "dumbfound" everybody by some trick or other over the flight line.

The commander of the Air Force brigade allowed Polunin to take off in his new R-5 which had a more powerful motor. "Well, in this 'dragon', I'll certainly find out if I can manage a maneuver!" decides the pilot. After revving it, he put the plane through a loop. At the highest point, he "twisted" into a half-roll. Suddenly he had a feeling that the craft was behaving abnormally. The reason was obvious: the front strut joint of the upper wing had torn away from the wing center section. The left wing cell was drooping and might collapse. "Shall I jump? No! The same thing might happen at the front too!" He cut the gas. The wing cell straightened out, held by the support wires. Carefully guiding the craft, Polunin glided with the motor off. He landed right next to the wind tee.

Similar "quests" were only growing pains.

In the Transbaikal area, Capt. Polunin was appointed district inspector of piloting technique. While checking on the piloting ability of the pilots of the district, he regarded aerial stunting with different eyes.

...1941 arrived. The regiment was west of Belostok. The commander asked: "How much time do you need to retrain the flying personnel from flying the I-16 to the new MiG-3 fighter?"

"We'll try hard to do everything as fast as possible", replies Maj. Polunin, commander of the fighter air regiment.

The "MiG's" arrived in crates. No one had flown them as yet. The regimental commander took off himself. On a fighter trainer he selected flight regimes approximating those of an MiG. He sent the squadron commanders out in the new craft. In checking the pilots who were ready for graduation, Maj. Pulinin carried out 104 flights.

On 22 June 1941, having mastered the new craft in good time, the regiment made several combat sorties against Fascist bombers.

Soon after the beginning of the war, Polunin's air regiment, armed with new high-altitude fighters, covers the sky over Moscow. It hunts down reconnaissance craft flying at high altitudes. As a rule, the enemy craft would fly out at the same time of the day, at the very same altitudes and over the same routes. Without waiting for reports from VNOS [aircraft warning service] posts, Polunin would in advance take his fighters up into quadrants where the enemy was likely to appear. In a short time, the pilots of the regiment downed the first enemy reconnaissance craft: two Junker-88's and one Dornier-217.

...A spacious office. Behind the desk stands a tall general, beginning to turn gray. In front of him, Maj. Polunin had drawn himself up to attention.

"Comrade General", requests Polunin, "I'm the one who formed this regiment. I've grown used to the men. There's nothing more important than the sky over Moscow!"

"Yes there is. We're defending the sky over Moscow, but we'll finish off the enemy in the sky over Berlin. You'll go to the Volga district. After all, it's a great honor to train new forces for the offensive!"

And Polunin gives all his experience and skill to the business of training the Air Force reserve.

The Communist Party teaches us to look ahead and not to stop at what has been achieved. During the very first year after the war, a new, qualitiative improvement of the Soviet Air Force was begun: jet equipment was added to our armaments. It was proposed to Lt. Col. Polunin that he master the jet aircraft. He welcomed the proposal with tremendous enthusiasm. When he arrived at the test flight airfield, only a few test pilots were flying the new craft. And now on 28 September 1946 Polunin was the first of the Air Force line pilots to fly in a jet plane.

At that time advanced piloting had not been carried out on jet craft anywhere in the world. As always happens when a new, unknown and — consequently — dangerous business is being mastered, there were sceptics who came out against advanced maneuvers on a jet craft. They tried to convince others that it was very dangerous and almost impossible, that the absence of an air screw could lead to the craft's loss of controllability during piloting. Finally, they asserted that powerful local shock waves could destroy the craft.

But Soviet pilot I. P. Polunin decided to carry out a complex of advanced piloting maneuvers on a jet plane.

After a sortie on a Yak-15 jet fighter trainer, he started reading books on aerodynamics. He drew sketches, computed the radii of circular maneuvers, and computed banks and speeds. He used every flight to analyze the possibilities for advanced piloting. He started with small steep turns. He carried on the work gradually, introducing all pertinent elements into a maneuver in consecutive order. He checked his theoretical computations in the air; he analyzed every flight on the ground. And only after he had carried out the quick succession of single and double

figures which he had developed, did he consider his work completed. At that time other Soviet pilots too had also begun to master advanced piloting on jet fighter aircraft.

On 31 October 1946 Polunin had to test-fly a craft that had arrived from the plant. It was a fine autumn day, the air was calm and transparent. Suddenly the Yak-15 rushed headlong from behind a forest, hedgehopping. It was obviously flying at top possible speed. Over the center of the airfield, the craft instantaneously raised its nose upwards and went into an ascending multiple spin. A whistle and a roar came rushing down to the ground. Again an ascending spin. From that the silvery craft darted down in a nose dive, while turning 180°, without stopping, around its longitudinal axis. Only the wings flashed in the sun. After sweeping by over the ground, the craft went from the dive into a climb with ascending barrel rolls. The pilots, engineers, technicians, and workers, unable to tear themselves away, followed every movement of the craft. Now an unusually tremendous Nesterov loop, all studded with rolls — and, with a smooth turn, the craft entered the landing pattern.

Tushino Airfield

The Polunin "swing": 1-an ascending spin at a 90° angle with recovery into a Nesterov half-loop with a wing-over, a nose dive with a 180° turn; 2-a double ascending Nesterov half-loop; 3-an ascending barrel roll at an angle of 80° with recovery into a zooming turn; 4-a double ascending barrel roll with recovery into a loop, a turn on a dive at 180°; 5-a Nesterov loop with seven barrel rolls; 6-withdrawal in a chandelle with maximum gain in altitude.

When Ivan Polunin climbed out of the cockpit, he was joyfully surrounded by an animated group of people. They all congratulated him, embraced him, shook his hand.

Thus for the first time in the world advanced piloting was carried out on a jet craft.

Polunin's achievement was not chance, it was the result of the qualitative improvement of Soviet aircraft construction. Under his leadership, a Yak-15 flight takes off for the first time in formation. It consisted of pilots I. P. Polunin, V. V. Yefremov, and A. K. Pakhomov.

The first to make creative use of, and to enrich the experience of Polunin, was Hero of the Soviet Union, Col. N. I. Khramov. Together with pilots, Hero of the Soviet Union V. V. Yefremov and P. G. Solov'yev, he for the first time carried out group piloting in jet aircraft.

Many pilots knew and loved this short robust fellow with the attentive gray eyes. His work as instructor pilot and his rich combat experience developed methodical habits, persistence, and sangfroid in him.

Spring 1943. At the front, preparations are going on for the Battle of Kursk. N. Khramov is teaching young fighter pilots to conduct combat operations. Here he is flying in a pair with an inexperienced junior lieutenant at an altitude of 3500 m over the front line. The sky is clear. The sun is shining brightly.

"Watch out", Khramov shouts tersely into the ether.

The young pilot brought his craft up close to Khramov's.

"Up in front, to the left, up higher, there are four 'Messers'. Do you see them?"

"Yes, I do!"

"Don't be afraid of their superiority. They see us. They want to approach us out of the sun. Let them keep looking."

"I get you."

"Now it's time. Down, left, under them. Combat turn — and we ourselves will attack from under the sun. Let's go!"

The pair of "Yaks" dive headlong towards the ground.

The Fascist pilots were bewildered; while they had made a turn for a surprise attack from above, the pair of Russians had disappeared.

At this time the Soviet "Yaks" dive onto the Fascist group from above.

"I'll get the flight leader. You get the leader of the second pair".

The Fascist group commander's plane, after rolling over on its wing, twisted in an uncontrolled fall. The disabled leader of the second pair, leaving a black trail of smoke behind him, headed sharply downwards. The wingmen lost their heads and scattered in various directions.

"That's my first kill!" shouted the young pilot in joyous excitement.

"Watch the air. That was a bad aim. You didn't finish him off."

That's the way Khramov taught. During similar demonstrations in his "sky class", he downed 8 Fascist aircraft. Altogether he downed 18 enemy aircraft and carried out more than a hundred air battles.

During the course of his entire flight work, N. Khramov distinguished himself by his quest for new ideas, by his ability to analyze successes and failures, and by his creative approach to the solution of complex aviation problems.

These invaluable qualities have brought him into the first ranks of those who began persistently and with love to master jet equipment. Bolshevik inquisitiveness prompted Khramov to conclude that it was possible to carry out advanced piloting in group formation in jet aircraft.

The day arrived when he revealed to his comrades in service and in flying a plan for piloting in a flight element. All three, N. Khramov, V. Yefremov, and P. Solov'yev, leaned excitedly over the sheet of paper. Discussing every piloting maneuver according to its elements, they worked out a unanimous plan for carrying out the complex of maneuvers.

Before beginning the piloting in a flight element, they had to master advanced piloting individually. Then in close flight formation they began to work out the take-off, straight and level flight, and flight in a wide circle. What had worked easily on conventional aircraft turned out to be difficult on jet craft: at shortened intervals and distances the formation broke up. The three sat, racked their brains, and looked for a solution. Theoretical computations were supplemented by persistent training in the air. What they did not succeed in doing right away in flight formation, they would carry out in pairs — now they flew in left bearing with V. Yefremov as wingman, now in right bearing with P. Solov'yev. Finally the flight achieved the maximally close "wedge" formation. Holding a wing-to-wing distance of half a meter, they carried out all the simplest maneuvers.

Khramov decided that it was time to start on advanced piloting. It must be said

that the pilots of the flight were closely knit together, as it were, in thoughts and in actions. Khramov's methodical habits and his ability to analyze strictly were complemented by the energy and great experience of V. Yefremov, and the qualities of both of them were intensified by the endurance and faultless piloting of P. Solov'yev. They developed the following complex of advanced piloting maneuvers for the flight: a loop, a zooming turn, a loop, a barrel roll, a nose dive, a steep zoom.

They managed rather swiftly to carry out the most difficult maneuvers: a loop and a zooming turn. But for a long time they could not accomplish a barrel roll. Thus if the barrel roll was to the left, then P. Solov'yev, the right outside wingman, found it very difficult to keep up. After a few failures, they had to change the technique of making a barrel roll. The first half of the barrel roll was made by Khramov with a combat turn, with a slight deviation from the flight axis.

Thanks to the persistence of the pilots, and the creative resourcefulness of N. Khramov, they started to execute perfectly all the most complex maneuvers of advanced piloting in a flight of jet aircraft.

On Air Fleet Day 1947, advance piloting on jet craft was to be demonstrated publicly for the first time in the world. In preparing for that day, Col. I. Polunin, after having performed the most magnificent individual piloting, carried out about 100 training flights. N. Khramov's group took off for training more than 120 times.

On 3 August 1947, when the Kremlin chimes had finished ringing three o'clock in the afternoon, the silvery voice of the bugles at the Tushino Airfield announced the beginning of the Air Force Celebration.

The moment arrived when the jet craft piloted by I. P. Polunin (see figure) inscribed its remarkable vertical maneuvers on the blue screen of the sky. Following after him the sky was crisscrossed with a swift cascade of piloting by N. I. Khramov's flight of jet aircraft.

Thus Soviet pilots won priority for our Motherland, being the first to have mastered advanced individual and group piloting on jet aircraft.

Thousands of Soviet pilots have traveled the path of piloting pioneered by the innovators.

FROM THE EDITOR'S MAIL

CLASS RATING OF THE INSTRUCTOR PILOT

Class rating is the primary and chief index of flying qualification which stimulates the constant improvement of flying personnel.

According to the situation that has obtained till now, aviation school instructors have been awarded the next higher class rating on the same general basis as pilots and navigators of line units. It seems to us that such a system should be reexamined, inasmuch as it does not take fully into account the specific nature of the work of the aviation school instructor.

It is well known that even the range of duties of a school instructor is different from that of pilots of a line unit and even his flying time is greater. But the whole thing is that the instructors start their program over again from the beginning every year. To some it seems that they are at one and the same level of flying training. Actually, however, an instructor's skill — flying and methodological — is indubitably sharpened from year to year; he becomes more and more of a mature expert in training and indoctrination, and gives more and more to his trainees in accordance with his own growth.

Nevertheless the growth of his professional skill is actually not stimulated. If, at best, he is able to reach the level of military pilot second class, it is nevertheless impossible for him to get first class rating, even though, according to all data, as an instructor at an aviation school, he fully deserves to be awarded the highest rating.

Why does it happen that way? Because, in order to receive the first class rating in full accordance with regulations, he must have a very solid amount of flying time under adverse weather conditions. But an instructor at a school, even with the best of intentions, cannot have such flying time. He flies with a different purpose and in a different situation.

On the other hand, let us assume that a military pilot first class is assigned to a school as instructor out of his line unit. Regardless of how well he flew he nevertheless has to adapt himself, and acquire the methodological habits necessary for working with trainees. Time will pass and he will, of course, master all that; he will become a real instructor. But at the same time, he will cease, to all intents and purposes, to correspond to the classification of a military pilot first class, since he will not be able to fly systematically under adverse weather conditions.

What is the answer then? How can we stimulate constant striving on the part of the instructor personnel of our Air Force schools to perfect their professional skill?

We can take the following course. While maintaining the former system of classification, we can give the instructors the opportunity to fly under adverse weather conditions just as in a line unit. But experience shows that it is unfeasible in actual practice, for it will complicate the scheduling and organization of flying in the schools.

Another way is to set up a special classification for aviation school instructors, for example, "military pilot (or navigator) - instructor first, second, and third class." As the basis of this classification we should place the chief specific features that characterize an instructor's level of skill: his methodological habits, the number of groups of trainees he has trained and his non-accident record in flying work, and his flying skill. (For the highest class rating, obviously a fixed amount of flying time is necessary, under adverse conditions, at night, for combat employment; but all that must be within the limits of what is possible for the schools.)

There is no doubt that this is the correct way.

The question of raising the class rating of instructors is not only a question of personal perfection of their flying and methodological skill; upon its correct solution also depends to a considerable extent the quality of the training of flying youth — of replacements for line units. That is why a special classification must be set up for the instructor pilots of aviation schools.

Instructor Pilot Capt.
P. S. Khudyakov

A RECOMMENDATION WITH WHICH IT IS IMPOSSIBLE TO AGREE

In Issue No. 3 for 1957 of the journal "Herald of the Air Fleet" an article was published by Engineer Maj. I. A. Globus entitled "The Successful Operation of Radio and Radar Systems". In this article a method was proposed for checking the efficiency of the receiver by adjustment of the heterodyne of the KLB [radar channel] unit to the frequency of the second channel. The author maintains that if the main switch is in the "Receive" position and a pulse is observed on the indicator tube when the channel is tuned in, then the receiver should be replaced.

We cannot agree with this recommendation. And here is why. In such an instance the signal of the image channel or of the spurious frequencies may be visible on the indicator tube. Such a phenomenon frequently occurs when the frequency characteristic of the receiver is taken. The relatively high output of the heterodyne's source of oscillations, its close coupling with the receiver, the amplification of which is sufficiently strong, does not preclude the possibility of a clear "parasitic pulse" appearing on the indicator tube.

Furthermore, if the heterodyne is constantly tuned on the various frequency bands of the receiver against the background of its set noises, a flattened, but quite definite pulse can be observed. This is explained by the fact that the frequency spectrum of the square pulse creates additional conditions for the appearance of spurious frequency signals.

The exact functioning of the electronic system depends to a great extent on the duration of the relay pulse of the ground station. For the receiver to have a broad passband, a multistage intermediate frequency amplifier with stagger-tuned circuits is required. This makes it possible to obtain a high amplification factor and to approximately double the passband.

At the same time even such an amplifier has shortcomings, since the passband and the amplification depend heavily on the tube characteristic. A tube with a higher transconductance has too great a spread of input and output capacitance; this can weaken the signal. That is why, after replacement of the tubes, it is necessary to align the intermediate frequency circuits. In our unit a special bench has been set up for this purpose on which this work is carried out with the help of a meter wave generator, an oscilloscope, and a rectifier. This work consists of the following.

We remove the left side panel and take out the heterodyne tube. To the socket of the L5-9 tube(contact 7) we solder a wire, 10-15 cm long, and we pass the other end through an opening in the panel and attach it to the vertical deflection terminal of the oscilloscope. With a feeder we join the output of the meter wave generator (GMV) to the antenna terminal of the receiver, which is fed through the rectifier.

Thus, the oscillating voltage, modulated by the square pulses, with an amplitude of 3-5 millivolts and a frequency equal to the mean value of the intermediate frequency is fed to the receiver from the GMV. Watching the signal on the oscilloscope screen, we decrease its amplitude until the set noises of the receiver appear. Then by means of the tuning adjustment screws of the 7th, 2nd, and 1st circuits of the UPCh [Intermediate frequency amplifier] we obtain a maximum output signal. In like manner, by changing the voltage frequency of the GMV within the limits of the upper and lower intermediate frequency as we adjust the 4th-6th and the 3rd-5th circuits of the UPCh.

We adjust the circuits several times, constantly decreasing the amplitude of the input signal in such a way that it is observed against the background of the receiver noises. We measure the passband of the receiver at a level of 0.5.

The results of many experiments have shown that after adjustment of the UPCh circuits, the sensitivity of the receiver can be higher than optimum. In such instances, it is not ruled out that the station's transmitter may be triggered by the set noises of the receiver. But even this can be readily eliminated. From the meter wave generator, we supply a voltage corresponding to the upper value of the intermediate frequency, and we turn the adjustment screw of the 4th circuit all the way so that the maximum voltage at the receiver input is not changed. Then, by supplying the voltage of the lower value of the intermediate frequency, we regulate the position of the core of the 3rd circuit in accordance with the maximum voltage at the receiver output.

By carrying out these steps, in the process of operating the electronic system, we widen the receiver passband to some extent and decrease its sensitivity by making use of the broad peak of the frequency characteristic and without changing the optimum values of the UPCh circuit tuning.

Frequently the passband is determined by the difference in meter scales, by first detuning the receiver to both right and left until the signal on the indicator is reduced to half of maximum. However, the values obtained in this case can be doubled, tripled, and sometimes even quadrupled, since they depend on the special hookup features of the receiver and its tuning.

By measuring the receiver passband on the bench, we can avoid such an error as well.

Engineer Lt. V. K. Baklitskiy

REVIEW AND PUBLICATIONS

ACTIONS OF A CREW IN AN UNINHABITED REGION

N. K. Pyneyev "Actions of an Aircraft Crew Forced Down in an Uninhabited Region".
Military Publishing House of the Ministry of Defense of the Union of SSR, Moscow, 1957. 195pp. Price 4 rubles 65 kopecks.

Recently a book by N. K. Pyneyev was published under the title "Actions of an Aircraft Crew Forced Down in an Uninhabited Region." The author of the book, a retired major general, is an experienced commander with a service record of over thirty years in the Air Force. During the war years he was chief of staff of an air army, and subsequently served for a long time in Air Force Headquarters. In retirement N. K. Pyneyev writes and edits books, takes an active part in social work. He has been recently elected chairman of the historical section of the Frunze House of Aviation.

The book consists of an introduction and four chapters which give a description of the actions of an aircraft crew who have made a forced landing or who have bailed out in uninhabited regions, far from populated areas and airfields. It also deals with landing on, or bailing out over, the sea, with search for an aircraft which has failed to return to its field, and with measures to be taken to rescue the crew.

The appearance of a book on this topic must be welcomed, since so far in the literature of aviation there have been no treatises similar to it. It is true that the flight characteristics of modern aircraft permit a well-trained crew to overcome difficulties encountered in flight and to carry out the assigned mission. However, instances are possible in which the aircraft may find itself, through serious combat damage or other emergency circumstances, in an out-of-the-way region; and for this it is necessary to be prepared. Pyneyev's book provides a minimum of useful knowledge and recommendations for the flying personnel on these points.

The author describes the measures to be taken by a crew prior to forced landing or abandonment of an aircraft; actions of the crew following a forced landing or landing with a parachute. Despite the fact that a part of these measures is described in the appropriate documents on flight procedures, their repetition in the book will not be superfluous. The material here is made more specific and is supplemented by useful practical advice. Quite correctly, a great deal of space is devoted to the method of assembly of the crew after landing and the administering of first aid for wounds and accidents.

Condensed, but clear and simple, is the description of the methods of orientation in a region. The author has shown how communication with the airfield is established and has mentioned everything the crew commander must consider when making a decision.

In considering the actions of the crew after they are forced to abandon an aircraft or land in Arctic, taiga, forest and swamp, steppe, desert or mountainous areas, the author gives a great number of recommendations on the construction of shelters, on hunting and fishing, collecting edible roots, grasses, berries, mushrooms, etc., and on preparation of clothing, conduct during marches, and administering of aid in case of accidents. This advice is undoubtedly useful to the flying personnel.

Landing on, or bailing out over, water is unusual. The book contains advice concerning this. There are also recommendations on signal arrangements, on consumption of available rations — particularly of fresh water, on hunting and fishing, on collecting of edible marine plants.

The book includes a chapter in which are discussed measures to be taken by the command in case of failure of a crew to return to the base airfield, arrangements for establishing communications with the crew and rendering the necessary assistance. Here the author gives pointers and recommendations on the collection of data necessary for making a decision to search; discusses how a search is conducted by aircraft as well as by land searching parties; gives an illustrative plan of their actions.

The book is well organized and has a great number of illustrations which facilitate the understanding of many questions.

However, despite a number of positive qualities, there is a number of assertions in the book by N. K. Pyneyev with which it is hard to agree.

The author recommends (p. 7) that in all cases and under all circumstances all possible measures be taken to report the accident by radio to one's commanding officer and receive his instructions before making a forced landing or bailing out.

This is correct for local flights or flights within the territory of the [military] district. In flights on routes or air lanes extending over long distances, the commander may not always be able to direct his aircraft. (In the Civil Air Fleet this is effected by the airways traffic control service.) Therefore the crew commander will maintain communications, if possible, with his commanding officer (operations officer); but first of all he will maintain it with the operations officers of those air fields and command posts of the commands in whose vicinity he is flying. If the necessity should arise of making a forced landing or of abandoning the aircraft, the first person to receive a report on this should be the official who is controlling or tracking the flight at that moment. The latter, upon receipt of the signal, will be able to render aid as soon as possible to the crew in trouble.

In the section on "Measures to be Taken Prior to a Forced Landing or Abandoning an Aircraft", the author recommends an excessive number of articles of personal use which the crew should have after a forced landing or bailing out. In this connection it is recommended that part of them be distributed through the pockets and packed in the usual bag (a bag of the gas-mask type). Such overloading with things and objects not provided for in the table of authorized items, especially in combat aircraft, may lead to serious complications in ejection. This will not be advantageous, but rather harmful.

In our opinion the book should not include tables of signals to be transmitted by signal panels, parachutes, and human movements, since all such signs and signals

for aviation must be universal and must be fixed by the agencies in charge of controlling flights in the territory of the USSR.

In the chapter on "Actions of a Crew in a Forced Landing on, or Bailing Out over, the Sea" many necessary questions have not been illuminated. Thus, the author has not said anything about the order of dropping rescue equipment to the water with and without parachutes by utilizing wind and drift, on vectoring of ships and cutters by the aircraft of the Rescue Service to the area of a forced landing or of a crew which bailed out over the water, nor on traversing areas of water set on fire, etc.

In the section on the search for the crew from the air, the author does not mention the use of electronic facilities. Electronic facilities in the possession of the crew which has suffered an accident and of the rescue aircraft will increase considerably the effectiveness of the search and will widen several times the search area as compared to visual means. In addition, such a search can be conducted under adverse weather conditions, i. e., in clouds and with low horizontal visibility.

On p. 186 the most advantageous altitude is given for the aircraft conducting a search as being 500-600 m and for helicopters, 200-300 m. It must be remembered that these altitudes are acceptable only for visual search. When using electronic facilities, the minimum altitude will be 1000 m. As the altitude increases, the operational radius will be greater.

One cannot agree with the assertion of the author (p. 53) that the warm currents of the Gulf Stream, in penetrating the Arctic Ocean and pushing back the ice floes from the shores of Europe, prevent only the western part of the Barents Sea and the northern part of the Atlantic Ocean from freezing. This can be understood to mean that the rest of the Atlantic Ocean freezes.

The word "base" is very frequently used in the book. "Base" is not an aeronautical, but rather a nautical term. By the way, let us remark that Pyneyev's book suffers from stylistic faults and is in need of a serious literary revision.

All of these shortcomings could be eliminated. On the whole, however, the book is necessary. Flying personnel will derive much useful information in reading it.

Col. S. N. Sibiryakov

120 THOUSAND KILOMETERS ON THE AIRCRAFT TU-104[1]

Military Pilot First Class Lt. Col. A. K. Starikov

3. OVER THE COUNTRIES OF THE SOUTH

It was in January of this year. Upon the invitation of the government of India, the Minister of Defense of the USSR, Marshal of the Soviet Union G. K. Zhukov flew to Delhi. Our crew had the task of taking the Marshal and his party to India.

Only a few months have gone by since the occasion of our flight over the countries of the south, and each one of us members of the crew of the TU-104 remembers well the details of that noteworthy air journey — noteworthy because till that time we, as indeed most of our professional colleagues, had not had occasion to fly in tropical regions, over countries where a bright sun shines the year round and the trees are green at the very height of winter.

Even during preparations for the flight we had already encountered difficulties. The first of them was the great length of the route over a terrain which lacked the necessary number of alternate airfields. The second was the absence, along the route, of indispensable facilities for finding one's bearings. This cannot be said, of course, about all legs of the journey; but several — very extensive in terms of flying time — had to be traversed, on the whole, by computing time and course. To these difficulties were added other less significant ones to which we also devoted our most serious attention. The high temperatures, for example. While at home in January the temperatures were 25-30 degrees below freezing, in some regions of India at that time the temperature reached 30 degrees above. All that compelled us to give careful study to the situation of the forthcoming flight, in books, reference manuals, and the accounts of experienced pilots. We can remark right here that in spite of all our efforts, we did not manage to get very much information about the special features of flying under conditions of the torrid zone, and, in addition, over mountainous terrain. Consequently every member of the crew considered it his duty, during the course of the flight, to observe flying conditions carefully, to make available information more precise and to draw his own conclusions.

We took off on a nasty day. The sky was completely covered with clouds which were no higher than 200 m. Immediately after takeoff our swift TU-104 plunged into a dull, murky shroud.

We soon reached an altitude of 9000 m, but we had not emerged from the clouds. The altitude was approaching 10,000 m, and the aircraft had to be flown on instruments. From time to time we broke out into a blue expanse, and then the pale winter sun would flood the windows of the pilot's cabin with golden light, but the clear space would suddenly end and we would again plunge into an ashen, milky shroud.

---

[1] Conclusion. (See beginning in Issues 5 and 6).

Marshal of the Soviet Union G. K. Zhukov entered the cabin. He examined our stations attentively, expressed interest in the members of the crew. He then turned to me with a question: "What speed are we flying at?"

I reported that the ground speed exceeded 1000 km/hr. The Marshal then turned to other members of the crew, questioned them about the purpose of the individual instruments, familiarized himself with the equipment in the cabin and remarked: "Complicated setup!"

We crossed the Volga. The flight up to the Volga had gone on under conditions favorable for orientation. The navigator's work became complicated after we had flown across the Volga. Then began the sparsely populated spaces around the Caspian, the Turanskaya Lowland, and the sands of Kyzyl Kum. In a section of the trip extending for about two thousand kilometers, there was only one good check point for the radar observation facilities — the Aral Sea.

We covered the distance from Moscow to Tashkent in 3 hours and 15 minutes. Our speed was very good. But ahead of us was a more complicated and crucial leg of the flight. All our thoughts were turned toward the next day.

The takeoff from Tashkent took place on the morning of the following day at 0715 hours. Our TU-104 was headed for the capital of India — the city of Delhi.

We climbed to a high altitude. The altimeter needle read 10,400 almost all the time. We began flying over mountainous terrain. The cloud cover here was not so thick, and the deck of the clouds scarcely reached half way to the mountain peaks. But the mountains are tremendous and eternally covered with snow. The flight route passed over the Pamirs — a mountain chain famous for its height. High parallel ranges stretched from the northeast to the southwest. In this same place was the Trans-Alai Range, crowned by Lenin Peak, and the Kashgar Range with Kongur Peak. The highest peak of the Himalayas and of the entire world — Everest — was off to the side of our line of flight. Its height is 8882 m. The eleven peaks of the Himalayas rose, like soldiers in formation, to a height of more than 8000 m. Here and there among the mountains, the gigantic valley bottoms showed white; early in the spring they become covered with wild vegetation, and then the mountaineers bring flocks of sheep to them. But now the mountains were mute and showed no signs of life. Settlements are sparse here; they are separated by the rocky giants and are scores of kilometers away from one another. And, of course, from our flying altitude it was difficult to determine the boundary between the USSR and the Chinese People's Republic, but the navigator informed us that the plane had crossed the border and that we were now flying over the territory of brotherly China. Orientation here was no less complicated than during our flight over the desert territory from the Volga to Tashkent. There are no homing radio stations here, nor are there any check points for radar observation. Again we determined the route by computing the time and the course. But it must be said that owing to the changeability of the wind in the mountains and to the absence of any reliable reports on the weather in this region, it was extremely difficult to make the computations. However, even under these conditions, Ivan Kirillovich Bagrich successfully carried out his tasks. He was helped by a thorough ground preparation. The navigator divided the entire mountainous region of our route into separate legs. He learned the characteristic features of each of them, singled out the chief and highest mountain peaks and memorized the contours of these peaks. And now, during the

Rangoon, at the Shive Dagon Pagoda.

flight, he was literally doing the impossible: he would point out to us one out of a dozen peaks among which there was, it seemed, absolutely no difference, and he would tell us that it was such and such a mountain and indicate it on the map. We were amazed at the navigator's memory and at his ability to "read" the ground.

We were also helped tremendously by two homing radio-stations that the Chinese turned on for us. They had set one up in Khatan and the other, in Kazhgar. They maintained contact with us in Russian. True, they spoke with a strong accent, but Belyayev, the ship's radioman, understood every word perfectly.

In addition to the usual orientation facilities the crew of the TU-104 had an astrocompass and an aircraft sextant at its disposal. We did not have to use them, however.

Our course formed a sort of huge arc and gradually inclined toward the south. Afghanistan, Pakistan, and Kashmir remained off to the right in the southwest. We flew over the cities and villages of great China, without experiencing any further difficulties in orientation. Besides the rather modern radio directional facilities at the disposal of the Chinese, we could check our route by means of the ship's radar.

Beneath us was the border between two great states: China and India. Sergeant Belyayev dispatched a radiogram to Moscow, where our flight was being followed attentively. We established contact with the Delhi airdrome in the international code. But when approximately 300 km remained to the Indian capital, we turned on the command radio set and started voice contact. The Indians asked us to specify our

time of arrival, and we said that it had not been changed: we would be at the airfield just, as had been previously announced, at 1000 hours Moscow time, or 1230 hours Delhi time. At this point we inquired about the weather in the airfield area and about the landing course. We received a comforting answer: "Cloudless, visibility 8 km, landing course 270 degrees."

Communications from the ground were maintained with us in Russian. The Indians gladly provided the Soviet specialists with the use of radio facilities, and this facilitated our work to a considerable extent.

The weather was splendid. There was not a single small cloud all around, right up to the very horizon. Only on the western side, high in the sky hung a strip of ashen haze. The sun which had risen over the earth was heating the walls of the cabin. There were no signs of winter; everything reminded us of Russian summer.

Only a few minutes remained till the end of the flight. As we found out later, those at the airfield were greatly excited.

"We can't see you!" we heard a voice from the command post.

We repeated that we would land at 0954 hours and would taxi up to the air terminal exactly at ten.

"But why can't we see you?" they asked us again.

This agitation was understandable to us. A few minutes remained till the landing, and our plane had not yet appeared. Not even the noise of the engines could be heard. They were assuming that our plane just like all others arriving at the "Palam"Airfield would make the traditional circle over the field; but we had decided to make a straight-in landing immediately.

We were approaching the runway at a considerable angle. At a distance of 4-5 km from the airfield, we made a sharp corrective turn and entered the landing course. At that moment they noticed us at the airfield. The "Palam" Airfield also was revealed to our eyes. Before turning our attention to the air terminal, we caught sight of the intersecting lines of the runways, and taxiways, and also the airfield buildings and hangars. The green color of the airfield was striking. It was as though the concrete runways had been constructed along a green carpet. It was now difficult to believe that on the day of our takeoff in Moscow it had been thirty degrees below freezing.

We made the landing exactly at the estimated time. But as soon as the aircraft touched down, I anxiously started to examine the airfield, mentally figuring out the taxi route to the air terminal. While we were still preparing for the flight, this step had appeared to me to be the most crucial. The entire difficulty lay in the fact that we were not well acquainted with the Delhi Airfield and could not foresee which runway we were to touch down on. But we considered it a matter of honor for the crew to maintain all deadlines with utter exactness, particularly the time for opening the doors of the plane and for Marshal G. K. Zhukov to step out of it. Where would the landing run of the plane terminate? Where was the place where the Marshal was to meet our Indian friends? Which way should we taxi? No sooner had the wheels of the plane touched the ground, when all these questions rushed upon me.

I will not describe how we carried out this difficult stage of our journey, but will merely say that we taxied up to the meeting place on time and opened the doors of the aircraft at the moment that the second hand of the clock ticked off the last minute before 1000. Marshal of the Soviet Union G.K. Zhukov and his party stepped out of the aircraft. The Soviet guests were met by the friendly applause of the hosts. The first to greet Marshal G.K. Zhukov was Doctor K.N. Katju, and after him, other officials. We watched the festive ceremony of welcome through the cabin windows. Flooded with sunshine, the "Palam" Airfield was filled with people. Above their heads was a sea of flowers. We pictured to ourselves how, the year before last, the Indians had greeted the leaders of the Soviet State, Comrades N.A. Bulganin and N.S. Khrushchev. And now, in the same place, and with the same joy, the friendly Indian people were greeting the Minister of Defense of the Soviet Union, the celebrated military commander of the Great Patriotic War, G.K. Zhukov. We saw him pass in front of a guard of honor. In the guard stood representatives of the three service branches of the Indian armed forces: infantrymen, sailors, and pilots. They were all distinguished by their excellent military bearing. The sailors perhaps were best dressed of all: they were wearing black outfits with strikingly prominent white belts. They wore leggings. The infantrymen were dressed in khaki-colored jackets and trousers. Their headgear consisted of berets with colored plumes. The pilots were wearing grey jackets.

Doctor K.N. Katju made a welcoming speech to the Soviet guests. He said:

"We are all happy that the commander of all of the great Armed Forces of the Soviet Union is here at my side. I am sure that as a result of this visit the good relations between us and the Soviet Union will be broadened more and more...

"Our Prime Minister, Nehru, when he was in the USSR, was greeted in a very cordial manner by the Soviet people. This was noted with gratitude by our people. We were happy to welcome Marshal N.A. Bulganin and N.S. Khrushchev here in India, and we are also glad to welcome you."

Marshal of the Soviet Union G.K. Zhukov made a speech in response. It was pleasant for us to see the Marshal cheerful and gay. I must admit that we had been worried that he would become exhausted during such a long and difficult journey. After all, the plane had traveled at a high altitude and then, too, there was the duration of the flight and the tremendous speed. But our fears had been groundless.

Turning to the hosts, the Marshal said:

"My dear friends! Allow me to express my deep gratitude to the Government of India and personally to the Prime Minister, Mr. Jawaharlal Nehru, for the kind invitation to visit India.

"The Soviet people regard with great joy the broadening and strengthening of our friendship with the Indian people. This friendship began to develop particularly rapidly after the historic visits of Mr. Jawaharlal Nehru to the Soviet Union and of N.S. Khrushchev and N.A. Bulganin to India. The growing friendship of our great peoples is determined by our mutual striving to have as many friends as possible."

Marshal G.K. Zhukov's speech was greeted with exclamations of general approval. The Soviet guests were presented with bouquets of flowers.

When the welcoming was ended and the guests, accompanied by the welcomers, had set off for the city, an airport employee came up to us and said that he had been charged with showing us the place for parking our aircraft. As during the time of landing, we now also noticed the dearth of people at the airfield, the absence of aircraft and of service personnel in its area. Only rarely did a man appear, and even then, not for long. At first we were ready to explain it as being due to the small number of aircraft arriving at the airport and leaving it; but later we found out other reasons as well. Among these may be included a very efficient system for servicing aircraft. In particular, we liked the technique for refueling aircraft and the refueling equipment. The fuel comes from the dump to the aircraft apron in pipes. Hose nozzles are brought out almost to the surface and closed with covers made of a strong kind of wood. The hatch covers are painted in two colors: white and red. Inasmuch as the color corresponds to a definite type of fuel, the place where gasoline or kerosene can be taken on is visible from a distance. On a special mobile unit set up between the fuel pump and the craft being refueled, a meter, filter and a receiving-distributing hose are mounted. One end of the hose is brought up to the nozzle of the pipe and the other up to the aircraft. We were amazed at the speed with which the Indians refueled our ship.

The Delhi "Palam" Airfield has been designed for receiving modern high-speed aircraft. It has two runways. We landed on a runway 2285 m long and 45 m wide. We would like to note one feature of the ground control facilities of the Delhi Airport. The homing radio stations there are not aligned with the runway but are somewhat to the side of it. In landing it is necessary to take into account the lateral position of the radio station and to make a corresponding correction in the course. We, however, did not have to do that, since the weather was clear and we could see the location of the runways.

I would like to note the friendly reception and complete trust accorded us by the employees of the Delhi Airport.

The city authorities lodged our crew in New Delhi, in the comfortable Hotel Jampat. For the entire time of our stay in the capital, two comfortable automobiles, constantly standing at the entrance, were placed at our disposal. We toured the city, became acquainted with the life of its population and saw the sights.

From time to time we visited the aircraft and did necessary work on it.

The Indian navigators were interested in our navigational equipment. Ivan Kirillovich told his colleagues about it and showed them his whole setup. General amazement was aroused by the ship's radar, the radio compass, and the navigational indicator. One of the pilots said: "I'd consider it the greatest joy to fly such a plane." But there were also questions that downright puzzled us. One aircraft engineer, elderly and very serious, asked:

"Whom does this machine belong to? Who is its owner?"

"The machine is ours..., that is, Soviet," we answered.

"You didn't understand me", said the engineer, "I know that it belongs to the Soviet Union. But what country was it built in?"

"The plane was built in the USSR."

"And who was its designer?"

"Andrey Nikolayevich Tupolev, a lieutenant-general, our aircraft design engineer."

Then our Indian friends entered into the conversation. They explained to their compatriot that the aircraft industry is well developed in the USSR and that there are even better aircraft there.

The conversation ended in general laughter.

Every day was filled with events which afforded us many impressions and will therefore be preserved in our memories for a long time. It is too bad that the scope of this article does not permit me to tell about everything in detail. Let us just note that on the second day after our arrival in Delhi the whole crew was invited to the celebration of Indian Republic Day. A liaison officer came to the hotel to bring us the official invitation and told us that he could accompany us.

The streets of the Indian capital were filled with festively dressed people. The diplomatic corps and numerous foreign guests were located at the most convenient spots of the main street of the city, the Rajpath (the "Government Avenue"). The liaison officer led us to a place in the center of the stands. And soon — this was at nine o'clock in the morning — a car drove up with a red flag. Out of it stepped Marshal of the Soviet Union G. K. Zhukov in full-dress uniform. He was met by members of the government. Marshal Zhukov was the most honored guest at the celebration.

But then the visit of the Minister of Defense of the USSR in India was over, and we flew to Burma. We set our course for Rangoon, the capital of friendly Burma. We approached Calcutta. The huge municipal airport was obscured by clouds and we did not succeed at this time in seeing it from the air. Over the Bay of Bengal we flew into the sun. In our latitudes at an altitude of 10,000 m, the temperature of the air would be minus 50-57°; but here it was only minus 27°. We all felt this difference keenly. The sun poured ultra-violet rays generously through the windows of the cabin. Our faces were burning. We awaited the end of the flight impatiently.

The temperature also had its effect on the operation of the engines. While still flying over the territory of India, we noticed that as a result of the high temperature of the air the plane was gaining altitude less rapidly. The delay in climbing resulted in increased fuel consumption. The negative effect of the tropical climate affected the operation of the engines at cruising speed also. For cruising speed to be maintained here, the turbines had to work at higher rpm than in our latitudes.

We landed in Rangoon at the scheduled time.

During our stay in Burma, a large number of foreign aircraft landed at the Rangoon Airport. Also among them were heavy twin-engine and four-engine planes — but all with piston engines. Our plane invariably attracted the attention of the foreign pilots and they plagued us with numerous inquiries. Everyone wanted to be photographed against the background of the TU-104.

And then we returned to India. Soon, too, came the day of our departure for the USSR. The farewell ceremony was just as solemn and stirring as the welcome. Marshal G. K. Zhukov was handed gifts and wreaths of flowers. The door of the cabin was closed and we taxied out to the runway. And again our plane was airborne. Knowing that the Marshal had been very busy before the flight, I was concerned about his condition. Wasn't he tired? I went out to the passenger compartment and saw that he was sitting over an open book and writing down something. His appearance, as always, was cheerful. From time to time he would get up and walk around the compartment, then sit down and write again. In general I observed that he was rarely idle. He was always reading or writing or entering into a serious conversation with someone. His work capacity could be envied. I suggested that he use the oxygen apparatus but he refused. By the way, I would like to point out that during our entire long air journey the Marshal did not use the oxygen apparatus even once. Yet this journey was very fatiguing even for us airmen.

At last our native land was beneath us. And even though the winter sun does not shine as brightly here as in tropical countries, we felt warmer because of the proximity of places dear to our hearts.

[CORRIGENDA]

[Issue No. 1, 1957, p. 3, line 26: "homing device" should read "computer".
" " " p. 12, line 20 from bottom: "foreshortening" should read "angle-off".
" " " p. 14, last line: "airborne RDF" should read "computer". (passim)
" No. 3 " p. 51, line 9 from bottom: "(navigation plotting scale - Tr.)" should read "(Navigator Service Manual - Tr.)".
" " " p. 52, line 3: "(airborne command post - Tr.)" should read "(alert command post - Tr.)".
" " " p. 100, line 7 from bottom: insert (after sentence ending "U.S. Air Force."): "They are given time for appearance on the local radio station. Besides, the recruiters regularly set up exhibits and poster stands on life in the Air Force."
" No. 4 " p. 12, line 25: "formation" should read "function".
" " " p. 52, in caption: "(bank indicator - Tr.)" should read "(speed indicator - Tr.)". (passim).
" No. 5 " p. 41, line 25: insert ω_f after "in" at end of line.
" " " p. 57, line 11: "bank" should read "bomb".
" " " p. 74, line 20: "[technical electrical units]" should read "[technical maintenance units]" (passim).]